

THE FAMILY TURRIDAE IN THE INDO-PACIFIC

Part I. The subfamily Turrinae

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The turrid gastropods comprise one of a group of five related families which form the superfamily Toxoglossa within the order Neogastropoda—1) Speightiidae, 2) Turridae, 3) Thatcheriidae, 4) Conidae, and 5) Terebridae. This monograph is the first of a series intended to cover the family Turridae. The turrids are the largest family group among the marine gastropods, and they occur from the intertidal zone to the abyssal depths and in all seas, including the Arctic and the Antarctic.

The term Toxoglossa refers to the extraordinary toxic property associated with a special type of radula which is found in many turrids, and reaches its climax of development in the Conidae. The radula of most toxoglossate gastropods is reduced to a single pair of slender marginals in each transverse row. In *Conus*, the teeth are barbed and lie loose in the radula sac from which they are ejected as individual harpoons.

Morphological Characters of the Turridae

The Shell of the Turridae—There is no characteristic turrid shape by which all members can be readily recognized, for many turrids simulate in shape such groups as the Buccinidae, Muricidae, Fasciolaridae, Columbellidae, Mitridae, Conidae, and even Terebridae. However, the one shell feature common to the members of the Turridae is a slit or shallow to deep sinus on the outer lip variously located between the suture and the periphery of the last whorl. In size, the adult turrid shell may vary from about 1 to 160 mm.

In the subfamily Turrinae, a well-developed sinus is situated either at the periphery or on a minor ridge immediately above it. Most Turrinae are fusiform with a tall spire and a long tapered anterior canal, although in some genera, such as *Xenuro-turris*, the base of the shell is truncated. Typical Turrinae closely resemble *Fusinus* (family Fascio-

laridae), the only apparent shell difference being in the presence of a turrid sinus on the outer lip. Characteristic labial profiles of the Turrinae are shown in plate 173, and of other subfamilies in plate 174.

The Protoconch of the Turridae—In most gastropod families the protoconch is fairly constant and characteristic, and is generally considered to be of importance in determining phylogenetic relationships. A radical difference in protoconch type usually suggests strong taxonomic dissimilarity. Some degree of difference in the size and number of the nuclear whorls exists within a species, depending upon the salinity variations in the environment; and there may be produced, again within the same species, either a short pelagic or a non-pelagic stage (in *Brachystomia*, Thorson, 1946, p. 206, and Rasmussen, 1951, pp. 210-221). Thorson (1950, p. 33) has shown that northern Arctic Naticidae have a nonpelagic development and hence a protoconch of large whorls, while Naticidae of temperate, warm seas have a short pelagic stage and a protoconch of small, more tightly-coiled whorls. However, Thorson placed all these species in the genus *Natica*, although, in fact, they belong to quite different genera having quite different opercula.

In turrids, there are species and genera which have almost identical adult shell characters, but which have quite dissimilar protoconchs. The significance of this phenomenon is not, as yet, completely understood, and in the present absence of

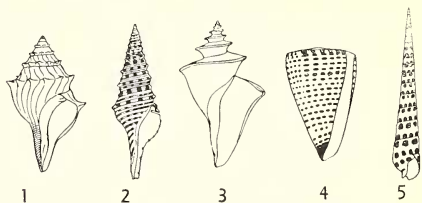


Plate 172. Five families of the superfamily Toxoglossa or Conacea. Fig. 1, Speightiidae (*Speightia*). Fig. 2, Turridae (*Turris*). Fig. 3, Thatcheriidae (*Thatcheria*). Fig. 4, Conidae (*Conus*). Fig. 5, Terebridae (*Terebra*).

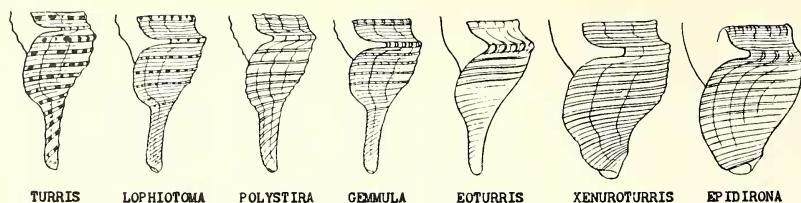


Plate 173. Labial profiles of genera in the subfamily Turrinae showing the characteristic shape and location of the sinus or labial slit.

life history and embryological facts, it is advocated that subgenera, or even genera, be recognized on the basis of the protoconch characters, even though the adult shells are almost identical. Examples of these "pairs" of higher taxa are the *Lophiotoma* and *Lophioturris* complex of species, and the *Tonnopeura* and *Maoritomella* group.

In all likelihood, the size of the protoconch and its number of whorls are correlated with the length of the free-swimming stage of the veliger. A protoconch of few, rapidly-expanding whorls suggests a short free-swimming life, while one of several, slowly-expanding whorls or one with a sinusigerous-like outer lip suggests a long-living, and hence far-travelling, larval life.

The Dentition of the Turridae—The radula in the Turridae is of several very distinctive types ranging from the prototypic form, with central, lateral and marginal teeth, through a series characterized by the absence of laterals but with a compensating enlargement of the central tooth, to finally the toxoglossate state, in which only the marginals, one on each side, remain.

The prototypic radula is found in the subfamily Clavinae in genera such as *Clavus*, *Drillia* and *Spirotropis*. The second group, minus laterals, occurs in the Cochlespirinae (*Aforia* and *Leucosyrinx*) as well as in the Turrinae, and in *Ptychosyrinx* and

Turridrupa. The third group, in which all but the marginals have disappeared, culminates in a radula form very close to that of the Conidae. The Mangeliinae, Daphnellinae and also some of the Clavinae have this toxoglossate style of dentition.

The radula form in the Turrinae and in some members of the Turriculinae is a modified toxoglossate type, having only marginals present, but these are "wishbone" in shape. They in turn show some relationship with the radula of the Clavatulinae in which the marginals are massive, often with one of the two extremities of the marginals existing as a separate plate. In addition there is an incipient or vestigial central tooth.

It was found that the prototypic style of radula was of common occurrence in many of the Clavinae, but on the other hand, quite a number of genera, *Phenatoma* for instance, with all the external shell characteristics of that subfamily, were found to possess only slender toxoglossate-like marginals.

Recently, Robinson (1960, Proc. Zool. Soc., 135, p. 319) has demonstrated that the English species of *Maugelia* are comparable with the Conidae in that the radula is truly toxoglossate, complete with the neurotoxic apparatus as well as a long proboscis capable of sufficient extension to harpoon prey.

These animals have a greatly coiled poison gland which opens ventrally into the oesophagus immediately posterior to the opening of the buccal sac. The poison gland is a coiled tube, and the swollen end of this gland is a propulsive organ, termed the

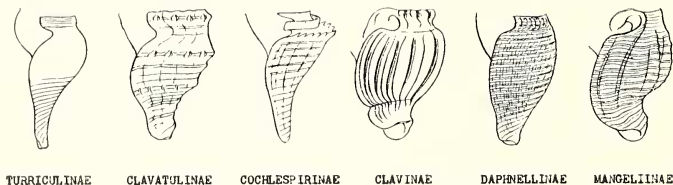


Plate 174. Labial profiles characteristic of other subfamilies in the Turridae. Turriculinae (*Turricula*); Clavatulinae (*Clavacula*); Cochlespirinae (*Ancistrosyrinx*); Clavinae

(*Cynatosyrinx*); Daphnellinae (*Daphnella*); Mangeliinae (*Etrema*).



Plate 175

- Figs. 1, 6 *Gemmula (Unedogemmula) unedo* (Kiener).
Japan (see text p. 22-761).
2, 3 *Lophiotoma (Lophioturris) indica* (Röding).
Cuyo Id., Philippines (p. 22-931).
4, 5 *Lophiotoma (Lophioturris) leucotropis* (Adams
and Reeve) (p. 22-932).
7, 8 *Gemmula (Unedogemmula) deshayesi* (Dout-
met), Hongkong (7), Japan (8) (p. 22-762).
9 *Lophiotoma (Lophioturris) indica* (Röding).
Philippines (p. 22-931).
10, 11 *Lophiotoma (Lophioturris) polytrypa* (Hel-
ling). Luzon Id., Philippines (p. 22-933).
12 *Xenuroturris cingulifera* (Lamarck). Zanzibar
(p. 22-962).

- 13 *Xenuroturris millepunctata* (Sowerby). New
Caledonia (p. 22-963).
14, 15 *Xenuroturris cerithiiformis* (Tinker). Hawaiian
Islands (p. 22-964).
16 *Lophiotoma (Lophioturris) indica* (Röding).
Moluccas.
17, 18 *Xenuroturris millepunctata* (Sowerby). New
Caledonia (p. 22-963).
19, 20 *Xenuroturris cingulifera* (Lamarck). Japan (p.
22-962).
21, 22 *Xenuroturris castanella* (Tinker). Hawaiian Is-
lands (p. 22-964).
(all 2/3 natural size)

muscular bulb, which functions in the harpooning of prey by means of poison-charged, detached radular teeth.

The fully developed toxoglossate dentition does not seem to be correlated with definite shell characteristics; in fact, it appears to cut across any subfamily arrangement based upon shell features alone.

The subfamily groups in use in the Turridae seem to form more or less natural groups that appear to have some geographical and chronological significance, yet the toxoglossate dentition is likely to develop in any one of them. It is probable, therefore, that a change from the prototypic to the toxoglossate state can take place independently in any one of the "subfamily" groups, and if so, no doubt as a direct response to a change to predaceous feeding.

If this is not the case, the inference is that the system of subfamilies at present in use is not morphologically sound, and merely indicates convenient groups of species based largely upon external resemblances. The following illustrations show some of the characteristic radula types in the Turridae:

The Operculum of the Turrids — The operculum is here considered to be of secondary importance as a taxonomic character, for after all, its shape is consequent to the shape of the aperture; opercular growth naturally takes the most convenient form to fill the apertural space. Opercular growth is achieved by means of a logarithmic spiral such as in *Turbo* or, as in the turrids, by the addition of concentric rings or the addition of excentric rings. For species with a long narrow aperture, the operculum is lanceolate or leaf-shaped. Excentric growth with an apical nucleus is the obvious mechanical method of growth in such types. The clavatulids, on the other hand, have a very different apertural shape, due to the lower median placing of the parietal angulation of the inner lip, and the adpressed suture which is clasped high over the preceding whorl. Thus by fan-wise excentric growth from a medio-lateral position the apertural space is best filled. A variation of the leaf-shaped operculum takes place where the aperture does not contract rapidly toward the anterior canal. The resultant squarish aperture is accommodated by an operculum in which the position of the nucleus may move over toward the outer lip in order to facilitate the mechanism of opercular growth.

Again in some abyssal genera such as *Steiraxis*, the operculum may become degenerate and remain

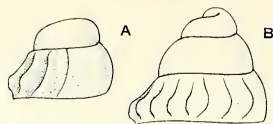


Plate 176 Example of paucispiral and polygyrate protoconchs in the Turridae. Fig. a, *Micantapex angustatus* Powell; fig. b, *Bathytoma bartrumi* Laws.

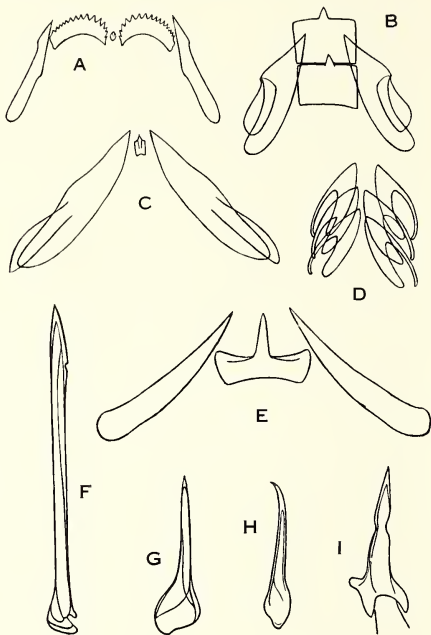


Plate 177. Radulae types in the Turridae. Fig. a, prototype with the central, lateral and marginal teeth present (formula: $1+1+1+1+1$), *Drillia unibilicata* Gray from West Africa. Fig. b, *Ptychosyrinx bisinuatus* (Martens) from East Africa in which the central tooth is enlarged to compensate for the loss of the laterals (formula: $1+0+1+0+1$). Fig. c, *Chionea sinuata* (Born) from South Africa with a small central and without laterals (formula: $1+0+1+0+1$). Fig. d, *Turris babylonica* (Linnaeus) from the southwest Pacific with only "wish-bone"-shaped marginals (formula: $1+0+0+0+1$). Fig. e, *Hormosira maculosa* (Sowerby) from West Mexico whose formula may be either $0+1+1+1+0$ (marginals absent?) or $1+0+1+0+1$ (laterals absent). Fig. f, *Phenatoma novaezelandiae* (Reeve) from New Zealand with only slender, barbed marginals (formula: $1+0+0+0+1$). Fig. g, *Microdrillia optima* Thiele from off East Africa with only awl-shaped marginals (formula: $1+0+0+0+1$). Fig. h, *Propebela turricula* (Montagu) from northern Europe (formula: $1+0+0+0+1$). Fig. i, *Daphnella cancellata* Hutton from New Zealand with marginals only (formula: $1+0+0+0+1$) (all greatly enlarged, but not to scale).

permanently ovate, of small size and without subsequent growth accretions.

The operculum is found to be absent in the Mangeliinae, or at least in the few species that have been examined. On the other hand, the complex of Boreale species, such as *Ocuopota*, "*Bela* auct." and "*Lora*," although closely resembling mangelids, possess an operculum.

The Daphnellinae are also supposed to lack an operculum, but one species, *Typhlodaphne purissima* (Strebel, 1908), from deep-water off South Georgia, has a vestigial operculum which is ovate, with an apical nucleus, and is very small in relation to the size of the aperture (Powell, 1951, *Discovery Rep.* 26, p. 196, fig. N.130).

Obviously, the operculum in the light of these considerations cannot be given a high taxonomic value.

Nomenclature of the Turrits—The Linnaean school did not distinguish turrits as a separate group but assigned them individually, according to appearance, to the genera *Murex*, *Buccinum* or *Strombus*. The earliest use of a group name for these shells seems to be the subfamily Pleurotominae of Swainson, 1840, in his "Treatise on Malacology" as one of four subfamilies of the Strombidae. However, H. and A. Adams, 1853, in "The Genera of Recent Mollusca" were the first to elevate the group to family rank, i.e., Turritidae; they admitted three subfamilies, the Turritinae, the Clavatulininae and the Defranciinae. Then for more than half a century the family name Pleurotomidae of Chenu, 1859, was in general use. With the recognition of Röding's Museum Boltenianum as nomenclaturally valid, *Pleurotoma* Lamarck, 1799, became a synonym of *Turris* Röding, 1798.

The acceptance of a family name based upon *Turris* Röding, 1798, to replace Pleurotomidae, based upon a synonym, is allowed under Article 40(a) of the 1961 edition of "The International Code of Zoological Nomenclature," and further, Article 40(b) rules that a name adopted by virtue of the provisions of section (a) takes the date of the rejected name.

The revised family name, however, has been rendered in two ways, i.e., Turritidae and Turridae. The first use of the former seems to have been by H. and A. Adams, 1853, in "The Genera of Recent Mollusca," but most modern authors since Hedley, 1922, have preferred the shorter rendering. The family name here adopted is TURRIDAE (= Pleurotominae = Turritidae = Pleurotomidae) Swainson, 1840.

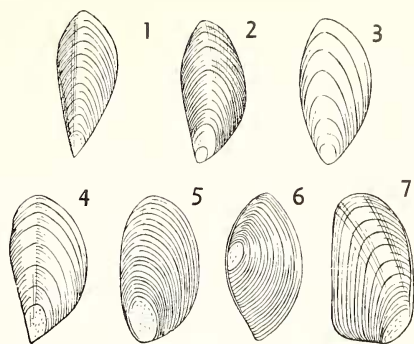


Plate 178. Opercula of Turritidae. Fig. 1, *Hormospira maculosa* (Sowerby), west Mexico. Fig. 2, *Crassispina pluto* Pilsbry and Lowe, west Mexico. Fig. 3, *Aotacadrilla otogensis* Powell, 50 fms. off Otago Heads, New Zealand. Fig. 4, *Xenoturris cingulifera* (Lamarck), Queensland. Fig. 5, *Tomopleura pouloensis* (Jousseaume), Aden. Fig. 6, *Pustocilla nifat* (Bruguère), northwest Africa. Fig. 7, *Aforia magnifica* (Strebel), Palmer Archipelago, Antarctic.

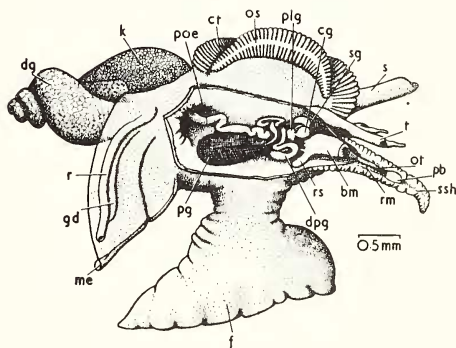


Plate 179. Gross anatomy of a turritid (*Mangelia poeysiana* Dautzenberg). bm, buccal mass; cg, right cerebral ganglion; ct, ctenidium; dg, digestive gland; dpq, duct of poison gland; f, foot; gd, genital duct; k, kidney; me, mantle edge; os, osphradium; ot, oral tube; pb, proboscis; pg, muscular sac, the so-called poison gland; plg, right pleural ganglion; poe, posterior oesophagus; r, rectum; rm, retractor muscle of proboscis; rs, radular sac; s, siphon; sg, salivary gland; ssh, suspensory sheath; t, tentacle (from Fretter and Graham, 1962, *British Prosobranch Molluscs*, Ray Society, London, p. 167, fig. 104).

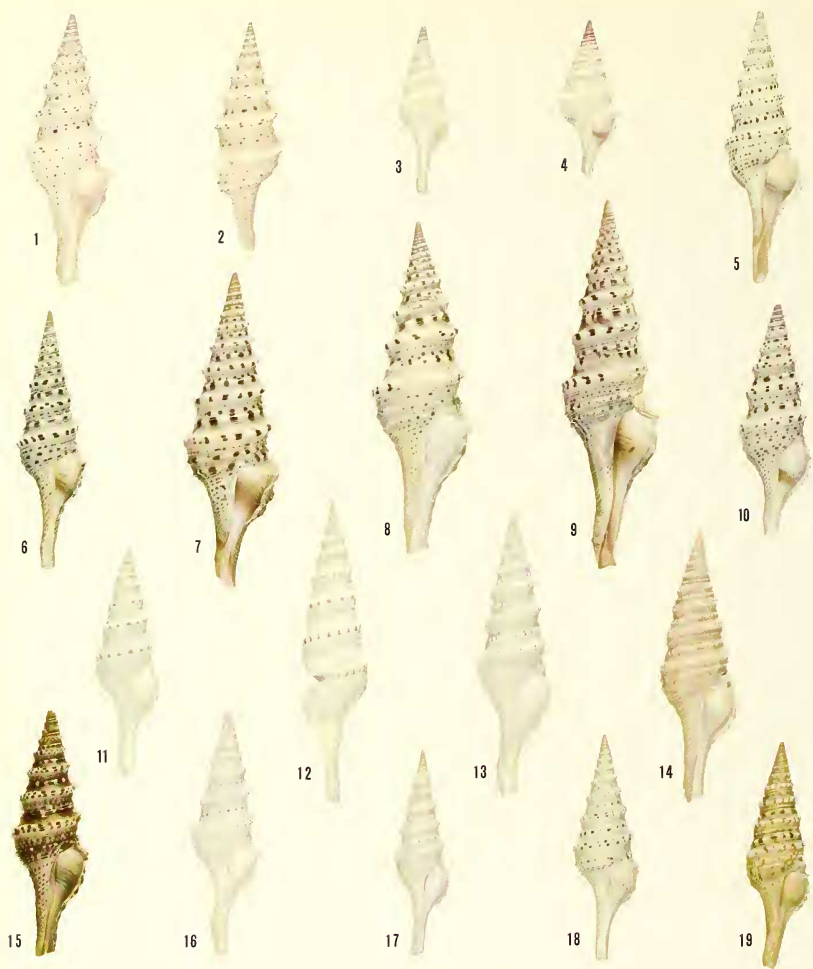


Plate 180 (see text p. 22-913)

All *Lophiotoma* (*Lophiotoma*) *acuta* (Perry) and its forms, except figs. 11, 12, which are *Lophiotoma albina* (Lamarck).

Figs. 1, 2 Bega Id., Viti Levu Id., Fiji.

3 Rani, west end of New Guinea.

4 Heron Id., Queensland, Australia.

5 Mindoro Id., Philippines.

6 *marmorata* form, west end New Guinea.

7, 8 Mozambique City, Portuguese East Africa.

9 Zanzibar Id., East Africa.

10 King's Reef, Queensland, Australia.

11, 12 *Lophiotoma albina* (Lamarck), Moluccas.

13 *L. acuta* form *microsticta*, Japan.

14 *L. acuta* form *jickelii*, Philippines.

15, 16 Zamboanga, Philippines and Palau Islands.

17 form *microsticta*, Ryukyu Islands.

18 Ryukyu Islands.

19 form *jickelii*, Red Sea.

(all natural size)



Plate 181 (see text p. 22-977)

- Figs. 1, 2 *Turris babylonia* (Linnaeus). Southwest Pacific.
 3, 4 *Turris babylonia* (Linnaeus). Philippines and west New Guinea.
 5 *Turris babylonia* (Linnaeus). Narrow form; Philippines.
 6 *Turris babylonia* (Linnaeus). Pale form; west New Guinea.
 7, 8 *Turris garnonsii* (Reeve). Zanzibar.
 9, 10 *Turris crisa* (Lamarck). Hongkong, 50 fms.
 11, 12 *Turris crisa* (Lamarck). Luzon Id., Philippines (11); Noumea, New Caledonia (12).
 13 *Turris crisa yeddoensis* (Jousseaume). Japan.

- 14, 15 *Turris cryptorhaphis* (Sowerby). Bohol Id., Philippines.
 16, 17 *Turris spectabilis* (Reeve), Philippines (16) and Moluccas (17).
 18 *Turris garnonsii* (Reeve). Slender form; Lubang Id., Philippines.
 19 *Turris annulata* (Reeve). Tosa, Japan.
 20 *Turris undosa* (Lamarck). Mindoro Id., Philippines.

(all 2/3 natural size)

For subdivisions of the Turridae the reader is referred to the writer's 1942 paper (see bibliography), in which the following subfamilies were adopted and diagnosed: Turrinae Swainson, 1840 (emended); Turriculinae Powell, 1942; Cochlespirinae Powell, 1942; Clavatulinae H. & A. Adams, 1848; Conorbinae Powell, 1942; Clavinae Powell, 1942; Borsoniinae Bellardi, 1875; Mangeliinae Fischer, 1887 and Daphnellinae Hedley, 1922.

In the same paper two new families related to the Turridae were proposed: Speightiidae and Thatcheriidae. Charig (1963, Bull. Brit. Mus. (Nat. Hist.) Geol. 7(9), pp. 255-297) relegated the latter to subfamily rank within the Turridae but this question will be discussed at the appropriate place in a later number of "Indo-Pacific Mollusca."

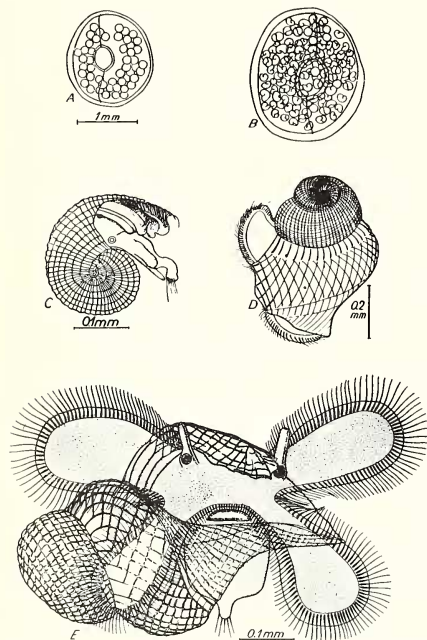


Plate 182. Development of a turrid (*Phalbertia linearis* Montagu from Denmark). Fig. a, egg capsule with young embryos. Fig. b, embryos nearly ready to hatch. Fig. c, hatched larva. Fig. d, older larva. Fig. e, older larva swimming showing the ciliated velar lobes (from C. Thorson, 1946, Reproduction and Larval Development of Danish Marine Bottom Invertebrates, p. 237).

Doubtless when more is known concerning the soft parts of turrids there may be considerable modification of the above subdivisions, but meanwhile they serve as a workable scheme and form the basis for future discussion.

Phylogeny of the Turridae — The earliest known undoubted turrid is apparently *Clinura anassa* Murphy & Rodda, 1960, from the Bald Hills formation, California, considered to be Cretaceous, late Albian to late Cenomanian. This species, however, is not a *Clinura*, which is a near ally of *Thatcheria*. Its affinity is more likely with the forerunners of the Turriculinae.

The previous earliest record for the family, *Turriculina unica* Gregorio, from the Liassic (Jurassic) of Sicily, is now considered non turrid, and has been placed by Wenz (1938, p. 391), with a query, in the family Coelostylinidae of the Loxonematacea.

The family Turridae is undoubtedly an older one than the Conidae and is considered the main stem from which the several toxoglossate families have at different times arisen.

The prototypic radula found in a number of turrid genera suggests that the derivation of the family was from the taenioglossids rather than from the rachiglossids.

Turrids were already well represented in the Upper Cretaceous, with six of the nine now recognised Recent subfamilies in evidence, and this indicates a much earlier inception for the family, but unfortunately there are no authentic records in support of such an assumption. Since the presence of some form of sinus in the outer lip is the only reliable indicator of a fossil turrid, it is unlikely that the early stages of differentiation for the family will ever be recognised.

Regarding the origin of the subfamily Turrinae, it seems likely that there is much closer affinity among the Turrinae, Turriculinae, Cochlespirinae and Clavatulinae than with the remaining subfamilies.

Detailed phylogenetic discussion will appear at appropriate places throughout the subsequent parts of this work.

Geographical Distribution of the Turrinae — The modern geographical distribution of the Turrinae differs markedly from patterns of the early Tertiary. For instance, *Gemmula* and a number of short-lived offshoots from it, characterized the Eocene horizons of Europe, England and the southern United States, but now Southeast Asia and vicinity has become the focal point for that genus and its allies. In fact, there is in that area an explosive develop-

ment with no less than thirteen living genera of the Turritinae alone represented. The Tertiary faunas of India, Burma, Java and Japan show that the Turritinae were already strongly entrenched in these areas from the Miocene onward.

However, very few members of the Turritinae have managed to penetrate farther eastward into the Pacific than the Western Pacific Arc, that geographical feature running from the Ryukyu Islands through the Philippines, New Guinea and New Caledonia to Fiji. The exceptions are *Lophiotoma acuta*, which has reached the Marshall Islands and Samoa; *Xenuturris cingulifera* and *millepunctata*, both of which are represented by derivative species in the Hawaiian group; *Turris spectabilis*, recorded from the Marshall and the Phoenix groups; *Turris cryptorhaphis*, also from the Marshalls; and a new subspecies of *crispa* from the Hawaiian Islands.

The Turritinae appear to be absent from the Society group and from most of the oceanic islands and atolls of the central Pacific. It is of interest, also, that the Turritinae are very rare at some of the atoll groups of the Indian Ocean, for Miss V. Orr, who recently collected intensively at Cocos-Keeling Islands, located only one member of the Turritinae, although small mangelids and daphnellids were there.

In tropical western America, the Caribbean and Florida, however, there is a development of large Turritinae, particularly in the genus *Polystira*, a shell that closely parallels the Indo-Pacific *Lophiotoma*, but has its own ancestry in that area by undoubted development from *Pleuroliria* of the Eocene and Oligocene of the southeastern United States. The genus *Gemmula*, wide-ranging both geographically and in time, also has representatives in tropical western America and off Florida.

In European-Mediterranean-West African waters, however, *Gemmula* is not represented, although it reached Pliocene times in England. The related *Fusiturris*, however, which has an unbroken ancestry back to the Paleocene, reaches Recent times in the Mediterranean and West Africa, and is the only large genus of the Turritinae still living in those areas.

The larger Turritinae of tropical America, the Mediterranean and the Indo-Pacific have obviously developed independently after the breaking up of that ancient equatorial waterway, the Tethys Sea. The cosmopolitan *Gemmula*, however, has in the main, retained its generic identity despite geographic segregating influences. Certainly a number of mutations have arisen from it at various times

during its long life from the Paleocene to the present, but nevertheless the tropical west American type of the genus, *hindsiana* Berry (formerly *gemmata* Reeve) and the deep-water Caribbean *periscelida* Dall, have all the essential characteristics of the Indo-Pacific members.

List of Recognized Taxa in the Turritinae

Below are listed the recognised generic and sub-generic taxa of the Turritinae, with species and subspecies. Taxa not represented in the Indo-Pacific are in square [brackets], and with these only the type species is cited. Fossils are prefixed by a dagger. Where a species occurs both Recent and fossil the dagger occurs after the name.

Included in the list are southern Australian Recent and Tertiary Turritinae, as well as New Zealand Tertiary members. Such species are not excluded since they have had an Indo-Pacific origin during past periods of the Tertiary when warm waters extended much further south than they do at present.

Subfamily Turritinae

[*Fusiturris* Thiele, 1929]

[*undatiruga* Bivona, 1832]. **Type**

***Gemmula* Weinkauff, 1875**

[*hindsiana* Berry, 1958] (= *gemmata* Reeve, 1843). **Type**

aethiopica (Thiele, 1925)

amabilis (Weinkauff, 1875)

†*binarginata* (Suter, 1917)

†*birmanica* (Vredenburg, 1921)

†*cliffdenensis* (Powell, 1942)

congener (E. A. Smith, 1894)

subsp. *cosmoi* (Sykes, 1930)

subsp. *diomedea* Powell, new subsp.

subsp. *mekranica* (Vredenburg, 1925)

†*miocoronifera* Powell, new name

dampierana Powell, new species

†*disjuncta* Laws, 1936

ducalis (Thiele, 1925)

†*duplex* (Suter, 1917)

†*gellibrandensis* Chapple, 1934

gemmulina (Martens, 1902)

gilchristi (Sowerby, 1902)

graeffei (Weinkauff, 1875)

hawleyi (Iredale, 1931)

hombrovi (Hedley, 1922)

†*imitatrix* (Martin, 1916)

iris (Vredenburg, 1921)

†*kaiparacensis* (Marshall, 1918)

†*karangensis* (Martin, 1895)

- kieneri* (Doumet, 1840)
 †subsp. *ryukyuensis* MacNeil, 1960
 †subsp. *woodwardi* (Martin, 1884)
 †*kishimaensis* Shuto and Ueda, 1963
 †*kotorai* (Nomura & Zinbo, 1935)
 †*laevis* Powell, 1942
 †*longwoodensis* Powell, 1942
 †*margaritata* (Marshall, 1918)
martini (Tesch, 1915) †
monilifera (Pease, 1860)
murrayi Powell, new species
 †*torba* Marwick, 1931
 †*ornata* (Marshall, 1918)
 †*pakistanica* (Eames, 1952)
 †*peraspera* Marwick, 1931
 †*polita* (Marshall, 1919)
praesignis (E. A. Smith, 1895)
 †*pulchella* Shuto, 1961
 †*reticulata* (Marshall, 1919)
rotatilis (Martens, 1902)
 †*sauneli* (Tenison-Woods, 1879)
sibogae (Schepman, 1913)
sibukoensis Powell, new species
 †*sindicus* (Vredenburg, 1925)
 †*soriensis* (Eames, 1952)
speciosa (Reeve, 1843)
 †*thyrsus* (Vredenburg, 1921)
vagata (E. A. Smith, 1895)
 †*waihaensis* Finlay, 1924
- Unedogemmula** MacNeil, 1960 (subgen. of *Gemmula*)
 †*bemueleni* (Oostingh, 1941)
binda (Garrard, 1961)
deshayesii Doumet (1839)
hastula (Reeve, 1843)
 †*haydeni* (Vredenburg, 1925)
tickel (Martin, 1906)
 †subsp. *virginoides* (Vredenburg, 1925)
indica (Deshayes, 1832)
fina MacNeil, 1960
 †*koolhoveni* (Oostingh, 1938)
 †*sondeiana* (Martin, 1895)
unedo (Kiener, 1839-40). **Type**
- Pinguigemmula** MacNeil, 1960
luzonica Powell, new species
 †*okinacensis* MacNeil, 1960. **Type**
philippinensis Powell, new species
thielei (Finlay, 1930)
- [Cryptogemma Dall, 1918]
 [benthina Dall, 1908]. **Type**
- [Carinoturris Bartsch, 1944]
 [adrasia Dall, 1919]. **Type**
- Ptychosyrinx** Thiele, 1925
bisinuata (Martens, 1901). **Type**
lobata (Sowerby, 1903)
 †*morensis* (Tesch, 1915)
 subsp. *teschi* Powell, new subspecies
truncata (Schepman, 1913)
- †**Kuroshoturris** Shuto, 1961 (subgen. of *Ptychosyrinx*)
 †*asukana* (Yokoyama, 1926)
 †*yugacensis* (Shuto, 1961). **Type**
 †*nipponica* (Shuto, 1961)
 †*totomiensis* (Makiyama, 1931)
- †[**Coronia** Gregorio, 1890]
 †[*childreni* Lea, 1833]. **Type**
- †[**Trypanotoma** Cossmann, 1893]
 †[*terebriformis* Meyer, 1886]. **Type**
- †[**Sinistrella** Meyer, 1885]
 †[*americanus* Aldrich, 1885]. **Type**
- †[**Infracoronia** Harris & Palmer, 1947] (subgen. of *Sinistrella*)
 †[*ludoviciana* Vaughan, 1896]. **Type**
- †[**Hesperiturris** Gardner, 1945]
 †[*nodocarinata* Gabb, 1860]. **Type**
- †[**Campylacrum** Finlay & Marwick, 1937]
 †*debile* Finlay & Marwick, 1937
 †*sanum* Finlay & Marwick, 1937. **Type**
- †[**Eopleurotoma** Cossmann, 1889]
 †*multicostata* Deshayes, 1834. **Type**
- †[**Oxyacrum** Cossmann, 1889] (subgenus)
 †[*obliterata* Deshayes, 1834]. **Type**
- †[**Eoturris** Finlay & Marwick, 1937]
 †*complicata* (Suter, 1917). **Type**
 †*multicincta* (Marshall, 1917)
 †*neglecta* (Suter, 1917)
 †*tuttlei* Suter, 1917
- †[**Epaxius** Cossmann, 1889]
 †[*crenulata* Lamarck, 1803]. **Type**
- Lucerapex** Iredale, 1936
casearia (Hedley & Petterd, 1906). **Type**
 subsp. *regilla* Iredale, 1936
carola (Thiele, 1925)
 “*denticulata*” (Thiele, 1925)
indagatoris (Finlay, 1927)
molengraaffi (Tesch, 1915) †
 †*murrayana* (Pritchard, 1904)
adenica Powell, new species
- †**Optoturris** Powell, 1944
 †*edita* (Powell, 1944)
 †*optata* (Harris, 1897). **Type**
 †*paracantha* (Tenison-Woods, 1877)
 †*kyushuensis* Shuto, 1961

- Epidirella** Iredale, 1931
xanthophaes (Watson, 1886). Type
†*sayecana* (Chapman, 1912)
- Epidirona** Iredale, 1931
†*adelaidensis* (Ludbrook, 1941)
beachportensis (Cotton & Godfrey, 1938)
candida Laseron, 1954
carinata Laseron, 1954
costifera Laseron, 1954
flindersi (Cotton & Godfrey, 1938)
gabensis (Hedley, 1922)
hedleyi Iredale, 1931. Type
jaffaensis (Verco, 1909)
molleri Laseron, 1954
multiseriata (E. A. Smith, 1877)
nodulosa Laseron, 1954
perksi (Verco, 1896)
philipineri (Tenison-Woods, 1877)
†*powelli* Ludbrook, 1957
quoyi (Desmoulins, 1842)
schoutanica (May, 1911)
†*suppressa* (Finlay, 1927)
torquata (Hedley, 1922)
tuberculata Laseron, 1954
†*cardoni* (Tate, 1899)
- Lophiotoma** Casey, 1904
abbreviata (Reeve, 1843)
subsp. *lifuenis* (Sowerby, 1907)
subsp. *ustulata* (Reeve, 1846)
acuta (Perry, 1811). Type
albina (Lamarck, 1822)
†*albinoides* (Martin, 1883)
brevicaudata (Reeve, 1843)
ruthveniana (Melville, 1923)
- Lophioturris** Powell, new subgenus
indica (Röding, 1798). Type
leucotropis (Adams & Reeve, 1850)
†*odengensis* (Martin, 1895)
polytropia (Helbling, 1779)
†*pseudofascialis* (Martin, 1883)
- †[**Pleuroiliria** Gregorio, 1890]
†[*supramirifica* Gregorio, 1890]. Type
- [**Polystira** Woodring, 1928]
[*albida* Perry, 1811]. Type
- †**Echinoturris** Powell, 1942
†*finlayi* Powell, 1935. Type
- †[**Veruturris** Powell, 1944
†*bisculpta* (Powell, 1944)
†*cochleata* (Powell, 1944)
†*quadracarinata* (Powell, 1944). Type
†*subconcava* (Harris, 1897)
†*tomopleuroides* (Powell, 1944)
- †[**Cinguliturris** Powell, new subgenus of *Veruturris*
†*tatei* (Cossmann, 1896). Type
- Viridoturris** Powell, new genus
corona Laseron, 1954. Type
- Xenuturris** Iredale, 1929
castanella (Tinker, 1952)
cingulifera (Lamarck, 1822). Type
subsp. *erythraea* (Weinkauff, 1875)
cerithiiformis (Tinker, 1952)
incredula (Iredale, 1931)
kingae Powell, new species
millepunctata (Sowerby, 1908)
- Turris** Röding, 1798
?ambages Barnard, 1958
amicta (E. A. Smith, 1877)
annulata (Reeve, 1843)
babylonia (Linnaeus, 1758). Type
crispa (Lamarck, 1816)
subsp. *intricata* Powell, new subsp.
subsp. *variegata* (Kiener, 1839-40)
subsp. *yeddoensis* (Jousseaume, 1883)
cryptorrhapha (Sowerby, 1825)
garnonsii (Reeve, 1843)
†*schwyni* (Pritchard, 1904)
†*septemlirata* (Harris, 1897)
spectabilis (Reeve, 1843)
undosa (Lamarck, 1816)
†*ugaliensis* Makiyama, 1927
- [**Antiplanes** Dall, 1902]
[*perversa* (Gabb, 1865)]. † Type
- [**Rectiplanes** Bartsch, 1944] (subgen. of *Antiplanes*)
[*santarosana* (Dall, 1902)]. Type
- [**Rectisulcus** Habe, 1958] (subgen. of *Antiplanes*)
[*mototinuai* (Habe, 1958)]. Type

Turridae to Be Dealt with in the Next Part

Turridrupa Hedley, 1922, *Austroturris* Laseron, 1954, *Micropleurotoma* Thiele, 1929 and *Taranis* (= *Fenestrosyrinx* Finlay, 1926 = *Allo* (Jousseaume) Lamy, 1934). *Bathytoma*, *Micantapex* and allied genera, despite the peripheral site of the sinus seem to have more in common with the *Borsoniinae*.

Doubtful Taxa in the Turrinae

The following species, mostly from the Tertiary of southeast Asia, cannot be satisfactorily evaluated at present, except that all appear to belong to the Turrinae. They are listed below under the genera to which they were ascribed by their respective authors.

Clacatula striata Gray, 1826

This is the type of the genus *Epideira* Hedley, but the type specimen of *striata* has not been found, and no shell from Western Australia, the presumed type locality, has been found which fits the rather undiagnostic description: "Shell ovate, turreted, whitish brown, with eleven or twelve longitudinal axial interrupted ribs forming long tubercles on the centre of the whorls; the whorls with distant impressed spiral lines near the suture with a rather flattened slightly nodulose band; the mouth rather more than one-third the length of the shell; outer lip thin inside, grooved; tail short, with a linear depression on its columella side; axis tent-twelfths, diameter four-twelfths of an inch." (in King's Narrative of a Survey . . . Coasts of Australia, London, 2, appendix, p. 485, [1827] 1826).

Genus *Epideira* Hedley, 1918 (Proc. Royal Soc. New South Wales 51, p. M79). An unrecognised genus with the type, by original designation, *Clacatula striata* Gray, 1826.

Pleurotoma (*Eopleurotoma*) *adela* Cossmann and Pissarro, 1909. Palaeont. Indica, N.S. 3, Mem. No. 1 (India (Ranikot Series, Tertiary)).

Pleurotoma (*Eopleurotoma*) *jhirkensis* Cossmann and Pissarro, 1909. Palaeont. Indica, N.S. 3, Mem. No. 1 (India (Ranikot Series, Tertiary)).

Pleurotoma (*Gemmula*?) *simplicissima* Thiele, 1925. Deutsch. Tiefsee-Exp., 17(2), p. 209, pl. 23, figs. 3, 3a; 5 × 1.8 mm. (off West Coast of Sumatra, 470 metres).

This is certainly not a *Gemmula* for the simple median carina is plain, and the rest of the shell smooth except for axials on the first two post-nuclear whorls. It may not even belong to the Turrinae for the nature of the sinus is neither figured nor described.

Pleurotoma (*Hemipleurotoma*) *bonneti* Cossmann, 1900. Faune Pliocénique de Karikal, p. 30, pl. 2, figs. 11, 13 (India, Karikal (Pliocene)).

Pleurotoma (*Hemipleurotoma*) *bonneti bhagathorensis* Vredenburg, 1925. Mem. Geol. Surv.

India 50(1), p. 51, pl. 12, fig. 5 (N.W. India, Sind, Nari of Bhagathoro Hill (post Eocene)).

Pleurotoma (*Hemipleurotoma*) *humilis iravadica* Vredenburg, 1921. Rec. Geol. Surv. India 53, p. 98, pl. 12, fig. 13 (Burma, Payagyigon (Kama Series, Neogene)).

Pleurotoma yenanensis Noetling, 1895. Mem. Geol. Surv. India 27(1), p. 42, pl. 10, fig. 3 (Burma (Tertiary)).

Pleurotoma (*Hemipleurotoma*) *yananensis narica* Vredenburg, 1925. Mem. Geol. Surv. India 50(1), p. 48, pl. 1, fig. 7 (N.W. India, Sind, Nari of Bhagathoro Hill (post-Eocene)).

Turris vandervlerki Beets, 1941. Geol. Mijnbouw Genoot. voor Nederl. en Kalonien, Geol. Ser. 13, p. 7, pl. 7, figs. 273, 274 (East Borneo, Mangkalihat (Upper Miocene)).

Turris (Gemmula) husamaru Nomura, 1940. Rec. Oceanogr. Works Japan 12, 1, p. 113, pl. 1, figs. 4a, b (Japan, off Tiba Prefecture). See pl. 207

Turris tigrinaeformis Nomura, 1935. Sci. Rep. Tohoku Univ., 18(2), p. 113, pl. 7, figs. 32a, b Formosa [Taiwan Island] (Pliocene)).

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EOCENE: *infracocænica* Cossmann, 1889; *lanbrierei* Cossmann, 1889; *prestwichi* Edwards, 1861; *wetherelli* Edwards, 1861.

Family Turridae

Subfamily Turrinae

Genus *Fusiturris* Thiele, 1929

Type: *Pleurotoma undatiruga* Bivona, 1832

Members of this genus still live in the Mediterranean and southward along the equatorial coast of West Africa. It has an European ancestry back to the Paleocene and is the European–West African counterpart of the Indo-Pacific *Lophiotoma*. *Fusiturris* and *Gemmula* have had a parallel development from the European Paleocene upwards, but apparently *Gemmula* is no longer living in the European–West African area.

Shell up to 50 mm. (2 inches) in height, elongate-fusiform, with a tall spire and long straight anterior canal. Protoconch small, narrowly conic and of three smooth whorls. Spire turreted; sculpture of wavy thin axials crescentically thickened at the narrowly rounded periphery. Sinus peripheral, moderately deep and narrowly U-shaped. Operculum leaf-shaped and with an apical nucleus.

Synonymy —

- 1929 *Fusiturris* Thiele, Handbuch der Systematischen Weichtierkunde, Jena, 1, p. 361 [type by monotypy of section of *Turris*: *T. (F.) undatiruga* (Bivona)].
1929 *Turrhenoturris* Coen, Atti. Soc. Ital. Milano, 68: p. 297 (type by Powell's 1942, p. 22, subsequent designation: *Pleurotoma undatiruga* Bivona).

Characteristic species —

RECENT: *undatiruga* Bivona, 1832 (= *balcata* and *corrugata* Kiener, 1839-40, = *similis* Dautzenberg, 1891), *torta* Dautzenberg, 1912.

PLIOCENE: *porrecta* Wood, 1848.

MIOCENE: *aquensis* Grateloup, 1832; *inermis* Hoernes, 1856; *mercati* Bellardi, 1877; *reevei* Bellardi, 1847.

OLIGOCENE: *conifera* Edwards, 1861; *difficilis* Giebel, 1864; *duchasteli* Nyst, 1836; *explanata* Koenen, 1890; *flexiplicata* Kautsky, 1925; *koeneni* Glibert, 1860; *plana* Giebel, 1864; *selysi* Koninck, 1837.



Plate 183. *Fusiturris undatiruga* (Bivona, 1832). Recent; Mediterranean. 46 mm. Type of *Fusiturris*.

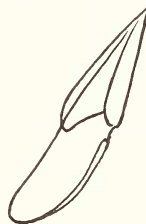


Plate 184. Marginal radular tooth of *Fusiturris undatiruga* (Bivona, 1832) (from J. Thiele, 1929, p. 361, fig. 441).

[These occasional blank areas occur between genera and subgenera to permit the insertion of new material and future sections in their proper systematic sequence.]

The Gemmate Series

The genus *Gemmula* has the most extensive Recent geographical range of any of the Turridae and it also extends back to at least the beginning of the Tertiary. It is the most vigorous member of the Turridae and undoubtedly represents the main stem of the subfamily. *Gemmula* is well-represented in the Tertiary of southern United States, Europe, India, Burma, Indonesia, Japan, Australia and New Zealand. The greatest development of *Gemmula* is now in the Indo-West Pacific. Very few species still exist in Caribbean-Panamic waters, and as already mentioned there are none from the Mediterranean and West Africa where the genus is replaced by *Fusiturris*.

Both *Gemmula* and *Fusiturris* seem to have had a common origin in the European Paleocene or earlier and both were well-represented throughout the Tertiary. All of the Eocene-Oligocene derivatives of *Gemmula* were relatively short-lived, as for example the European-American *Eopleurotoma*, the European *Epalxis*, *Hemipleurotoma* and *Oxyacrum*, as well as a group of New Zealand Upper Cretaceous-Eocene genera, *Campylacrum*, *Eoturris* and possibly *Tholitoma*.

Gemmula has the posterior sinus as a deep slit on the peripheral carina and in general the shell resembles *Lophiotoma*, except for the characteristic gemmate sculpture on the peripheral sinus rib.

The radula in *Gemmula* consists of a pair of marginals in the shape of a "wishbone," a type of dentition common to *Turris*, *Lophiotoma*, *Epitidirona* and some members of the Turriculinae.

Genus *Gemmula* Weinkauff, 1875

Type: *Gemmula hindsiana* Berry, 1958

It may appear that only small differences separate the bracket of names, *Turris*, *Gemmula* and *Lophiotoma*, especially the fact that the presence of gemmules on the peripheral carina is the only obvious difference between *Gemmula* and *Lophiotoma*, which has a plain peripheral sinus band. However, these differences, which appear slight when Recent material only is reviewed take on more significance when phylogeny is considered.

Synonymy —

1875 *Gemmula* Weinkauff, Jahrbüch. der Deutschen Mal. Gesell., 2: p. 287. Type by subsequent designation by Cossmann, 1896, p. 62; *Pleurotoma gemmata* Reeve, 1843 (non Conrad, 1835) = *Gemmula hindsiana* Berry, 1958.



Plate 185. *Gemmula hindsiana* Berry, 1958. Gulf of California. Formerly *Pleurotoma gemmata* Reeve, 1843, and Hinds, 1843; non Conrad, 1835 (from Harris, 1937, Paleont. Americana 2 (7), pl. 1, fig. 33). Type of *Gemmula*.

Key to the Gemmate Genera

- A. Protoconch polygyrate and axially costate; peripheral keel gemmate throughout.
 - 1. Shell elongate-fusiform, sinus deep and narrow *Gemmula*, p. 22-695
 - 2. Shell truncated anteriorly; sinus broadly V-shaped *Ptychosyrinx*, p. 22-851
 - 3. Shell broadly conic; keel placed low; sinus open 45° *Pinguigemmula*, p. 22-789
- B. Protoconch polygyrate and smooth, except for half whorl of axials; keel gemmate on early whorls only; shell elongate-fusiform *Unedogemmula*, p. 22-761
- C. Protoconch paucispiral, globose and smooth; sinus broadly V-shaped.
 - 1. Shell truncated anteriorly *Kuroshioturris*, p. 22-865
 - 2. Shell elongate-fusiform and smooth; except for a peripheral row of tubercles.
 - Lucrapex*, p. 22-837

1931 *Eugemmula* Iredale, Records Australian Mus., 18(4): p. 226. Type by original designation: *E. hawleyi* Iredale, 1931.

In addition to the large number of Indo-Pacific species either mentioned or described in the following text, *Gemmula* is abundantly represented in the Tertiary of both Europe and the United States of America.

Characteristic European Tertiary Species —

PALEOCENE: *gryi* Ravn, 1939. EOCENE: *acutangularis* Deshayes, 1834; *aspera* Edwards, 1861; *callifera* Edwards, 1861; *cancellata* Deshayes, 1834; *gentilis* Sowerby, 1850; *goosensi* Boury, 1899; *longaeva* Edwards, 1861; *monerma* Edwards, 1861; *nilssoni* Deshayes, 1865; *plebeia* Sowerby, 1850; *reticulosa* Edwards, 1861; *simillima* Edwards, 1861; *subcarinata* Rouault, 1850; *submonilifera* Boury, 1899; *taeniolata* Edwards, 1861; *teuistriata* Deshayes, 1834; *uniseriatis* Deshayes, 1834; *varians* Edwards, 1861.

OLIGOCENE: *bosqueti* Nyst, 1843; *humilis* Koenen, 1890; *laticlavia* Beyrich, 1848; *lunulifera* Koenen, 1890; *nodigera* Koenen, 1890; *odontella* Edwards, 1861; *odontophora* Koenen, 1890; *parkinsoni* Deshayes, 1865; *subdentata* Goldfuss, 1844.

MIOCENE: *annae* Hoernes and Auinger, 1891;

badensis Hoernes and Auinger, 1891; *contigua* Brocchi, 1814; *coronata* Goldfuss, 1844; *coronifera* Bellardi, 1877; *cossmanni* Peyrot, 1931; *cypris* Orbigny, 1852; *denticula* Basterot, 1825; *disjuncta* Peyrot, 1931; *rotula* Brocchi, 1814; *spiralis* M. de Serres, 1829; *stoffelsi* Nyst, 1843.

PLIOCENE: *antwerpiensis* Vincent, 1890; *monilifera* Brocchi, 1814; *turriifera* Nyst, 1853.

Characteristic American Tertiary Species —

EOCENE: *alternata* Conrad, 1833; *carodonta* Harris, 1937; *casteri* Harris, 1937; *conjuncta* Casey, 1904; *coraliger* Harris, 1937; *lancea* Casey, 1904; *lerchi* Vaughan, 1896; *ludocarola* Harris, 1937; *plentopsis* Harris, 1947; *sublerchi* Harris, 1937; *wateletella* Harris, 1937; *weisbordi* Harris, 1937.

OLIGOCENE: *amica* Casey, 1903; *ancilla* Casey, 1903; *tenella* Conrad, 1847.

It is possible that true *Gemmula* is represented in the Eocene-Miocene horizons of the west coast of North America, but material examined so far discounts this. The nearest approach to a *Gemmula* is *Surcula monilifera* Cooper, 1894, but although this Californian Eocene species has a beaded peripheral keel, the smooth conical three-whorled protoconch is atypical.

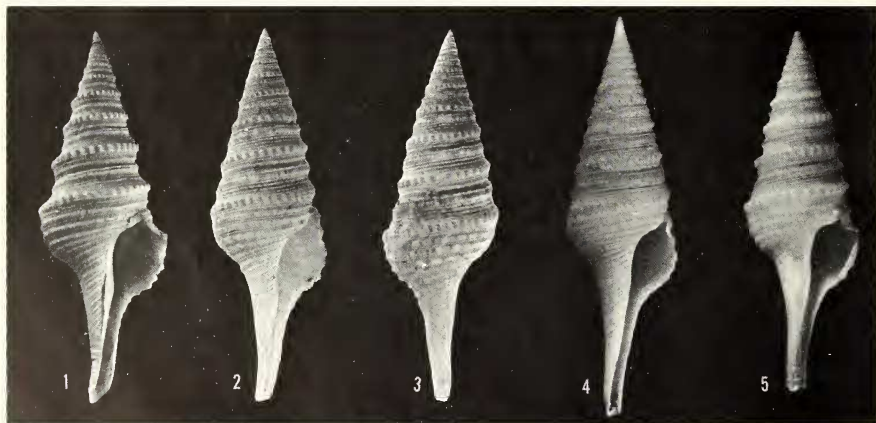


Plate 186

- Figs. 1 *Gemmula speciosa* (Reeve). Holotype of *Pleurotoma carinata* Griffith and Pidgeon, 1834, non Link, 1808. Australia. 73 mm.
2, 3 *Gemmula kieneri* (Doutet). 40 fathoms, off Tosa, Japan. 61 mm.

- 4 *Gemmula murrayi* new species. Holotype. Off Sharam, west coast of the Gulf of Oman, Saudi Arabia. 35.5 mm.
5 *Gemmula dampierana* new species. Holotype. 7 mi. N.N.W. of Anchor Island. Onslow, Western Australia. 35.5 mm.

***Gemmula speciosa* (Reeve, 1843)**

(Pl. 186, fig. 1)

Range—Philippines, China Sea and Arabian Sea.

Remarks—This very distinctive and uncommon species is at once recognized by its broad, cog-wheel-like peripheral keel which is regularly and closely studded with laterally compressed, raised gemmules. Further, there is a distinctive colour pattern of light-brown, continuous, spiral lines confined to the peripheral keel and the primary spiral cords. The closely allied *Gemmula kieneri* (Doumet) differs in having a heavier and less projecting peripheral keel, stronger interstitial spirals, as well as a more prominent subsutural fold. The colour markings of *kieneri* are not continuous lines, but are interrupted dots and dashes occurring between the peripheral gemmules and on the primary spirals.

Considerable confusion exists concerning the correct name to be used for this species, due to the erroneous and repeated statements that *carinata* Gray is synonymous with *kieneri* Doumet. Certainly, Reeve's 1843 *carinata* (Gray) appears to be identical with *kieneri*, but Gray's (in Griffith and Pidgeon, 1834) original *carinata* is undoubtedly the same as Reeve's *speciosa*. The latter name must be employed because Gray's name is preoccupied by *Pleurotoma carinata* Link, 1808. Because of this confusion, literature records of this species are not included here.

Melville (1917, p. 145) described a *Turris* (*Gem-*

mula) *granosa guadurensis*, from the Mekran Coast in 70 fathoms, as follows: "Testa ut in typo, sed omnino minor, fere immaculata, M. C. Gwadur, one specimen at 70 fathoms. A few others, all much of the same calibre, off Ras Maidani, between Gwadur and Jask. The sculpture of this variety is identical with the type; the size about half, say 38 mm., as against 60-70 mm., the coloration most simple, nearly immaculate."

Although the actual type of *guadurensis* was not located, an apparently authentic topotype from the late Mr. J. R. le B. Tomlin shows this alleged subspecies to be merely an immature *speciosa*, for it fits into the size range of a series of that species from Station 72, John Murray Expedition, from the Gulf of Oman in 73 metres.

These shells are identical in sculpture with *speciosa* but are almost lacking in coloration, although a faint pattern does show faintly in some of the larger examples. The Tomlin specimen is 37 mm. in height and has 7 post-embryonic whorls, in contrast to 8 or 9 in adult *speciosa*. From the above observations it is clear that *guadurensis* is not a dwarf form, as Melville believed it to be, but merely an immature *speciosa*.

Melville made *guadurensis* a subspecies of *granosa* (= *kieneri*) but that species has fewer peripheral gemmules. Counts showed that in *speciosa* the gemmules range between 33 and 46 per whorl (43-46 in adults), and in adult *kieneri*, 31-35 per whorl.

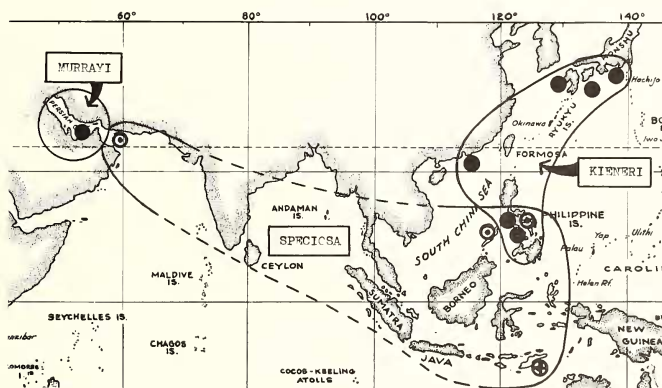


Plate 187. Geographical distribution of *Gemmula kieneri* (Doumet), *G. speciosa* (Reeve) and *G. murrayi* new species.

Fossil specimens are difficult to assign by illustrations alone, but it would appear that of the figured Upper Tertiary shells assigned to *carinata* by Tesch, 1915, only fig. 47a resembles *speciosa*, the remainder on plates 76 and 77 being sculpturally more in accord with *kieneri*.

Description — Adult shell 53.5 to 73 mm. (2 to 3 inches) in height. Fusiform, with tall spire and long tapered and slightly flexed anterior canal. Whorls strongly angulate and carinate at just below middle whorl height; base rather suddenly contracted. Peripheral carina a square-cut prominent flange densely studded with narrow, laterally compressed and peaked nodules which give a regular cog-like effect. Primary spirals plain, thin, but sharply raised, three above the carina, one of which is on a moderate subsutural fold, one or two below the carina, and about six on the base, exclusive of the canal. The secondary sculpture consists of from one to three plain weak threads in the interspaces of the primaries. The surface is crowded with weak, crisp, axial threads. Colour pattern of light-brown spirals on a buff ground.

The whole of the peripheral carina is uniformly coloured and all of the primary spirals are similarly tinted light-brown. There are no interrupted markings, dots or dashes.

Measurements (mm.) —

height	width	
73.0	26.0	type of <i>carinata</i> G. and P.
73.0	21.3	Samar Id., 35 fms., Philippines
53.5	19.0	Mantaquin Id., 27 fms., Philippines

Synonymy —

- 1834 *Pleurotoma carinata* (Gray) in Griffith & Pidgeon, Moll. & Radiata, arranged by Baron Cuvier, London, p. 599, Pl. 23, f. 2. Non *Pleurotoma carinata* Link, 1808; non *carinata* (Gray); Reeve, 1843, Conch. Icon. 1, pl. 7, fig. 56.
 1843 *Pleurotoma speciosa* Reeve, Conch. Icon., 1, pl. 2, fig. 9.
 1884 *Pleurotoma (Gemmula) speciosa* Reeve, Tryon, Manual of Conch. 6, p. 173, pl. 4, fig. 48.
 1915 *Pleurotoma carinata* Gray, Tesch, Palaont. von Timor, pl. 77, fig. 47a (only).
 1917 *Turris (Gemmula) guadurensis* Melvill, Proc. Malac. Soc., 12, p. 145.

Types — British Museum (Natural History), no locality (*carinata*).

Records — PHILIPPINES: off Badian Island, west Samar, 35 fms. (Albatross Sta. 5426); off Mantaquin Island, east coast, Palawan, 27 fms. (Albatross Sta. 5207) (USNM); Samar (coll. of A. D'Attilio, New York). ARABIA: Gulf of Oman, 73 metres (John Murray Exped. Brit. Mus. (Nat. Hist.)).

Fossil Records — Recorded from the Upper Tertiary of Timor (Tesch, 1915, p. 25, pl. 77, fig. 47a, only).

Gemmula kieneri (Dumet, 1840)

(Pl. 186, figs. 2, 3)

Range — Japan, China and the Philippines.

Remarks — Under *speciosa* Reeve, I have already pointed out that *kieneri* is very similar, but the peripheral keel in the latter is less projecting, the body whorl not so abruptly or so deeply contracted, and the colour pattern is in the form of maculations between the gemmules of the carina and interrupted dots and dashes on the primary spirals. In *speciosa*, all the colour lines are uninterrupted.

The species name *granosa* Helbling, 1779, has long been in misuse for this species which is common in Chinese and Japanese waters. Helbling's figure, however, depicts a misshapen specimen with a short anterior canal. There is a band of rounded gemmules subsuturally, the peripheral carina is studded with closely spaced, strong, round gemmules and all of the spirals below the peripheral keel are shown to be strongly and closely gemmate. It could be just a case of faulty draftsmanship but on the other hand Helbling's figures of other species in the same work are accurate and the species easily recognized.

No locality was given by Helbling and it is doubtful if the type specimen is still in existence. The wisest course is to drop the name as indeterminate and for this Oriental species employ Dumet's name, *kieneri*. The original reference is *Murex (Fusus) granosa* Helbling, 1779, Abhandl. Priv. Bohm. Math., Prag., 4, p. 116, pl. 2, fig. 22.

Description — Adult shell 56 to 73 mm. (2½ to 3 inches) in height, robust, fusiform, with tall spire and long rather straight anterior canal. Adult whorls, 10 or 11, rather tightly coiled. Spire whorls sculptured with a strong square-cut keel, situated below the middle, not prominently projecting and sculptured with numerous closely spaced rectangular nodules, which are laterally compressed. There is a strong subsutural fold bearing one primary cord and two threads, three or four sharply raised slightly imbricate threads between the subsutural fold and the peripheral keel and one primary cord and several threads between the periphery and the lower suture. Base, exclusive of the anterior canal, with about six primary cords and from one to three interstitial threads. Surface covered with dense lamellate axial growth threads which imbricate the secondary spiral threads. Colour maculated in light-brown on a white ground, with some obscure and irregular small blotches on the subsutural fold, with regular squarish spots between the gemmules on

the carina and with irregularly disposed spots on the primary cords of the base.

Measurements (mm.)—

height	width	
73.0	21.0	"India" (ANSP)
59.5	20.0	Tosa, Japan
56.0	17.5	Kii, Japan

Synonymy—

1840 *Pleurotoma kieneri* Doumet, Magasin de Zool. 2, p. 2, pl. 10.

1843 *Pleurotoma carinata* Gray, Reeve (non Gray, 1834), Conch. Icon. 1, pl. 7, fig. 56.

1909 *Pleurotoma carinata* Gray, Amandale & Stewart, Illus. Zool. Investigator, Moll. 6, pl. 20, figs. 3, 4.

1915 *Pleurotoma carinata* Gray, Tesch, Palaont. von Timor, pls. 76 and 77 (all figs. of *carinata* except 47a).

1955 *Gemmula granosa* "Helbling," Kira, Coloured Illus. Shells of Japan, Osaka, pl. 35, fig. 18.

*Records—*JAPAN: Tosa, 40 fathoms; Kii (ANSP); Sagami Bay, 40 fathoms (USNM). HONGKONG (USNM). PHILIPPINES: West of Pacyan Island, 189 fathoms, green mud (Albatross Sta. 5409); between Cebu and Bohol, 162 fathoms (Albatross Sta. 5412) (USNM).

*Fossil Records—*Recorded from the Upper Tertiary of Timor (Tesch, 1915, p. 25, as *carinata*), pls. 76 and 77, all figures of "*carinata*," except 47a.

***Gemmula kieneri subspecies
ryukyuensis* MacNeil, 1960**

(Pl. 188, fig. 3)

*Range—*Okinawa, Miocene or Pliocene.

Remarks—"This subspecies has a broader sub-sutural slope than is common for the species and the subsutural collar is weaker. It has fewer and larger nodes on the peripheral carina. All of the specimens at hand have two or three coarse spirals below the periphery, those below on the base of the body whorl and columella becoming much weaker. The latter condition is approached by occasional specimens of the more typical form of the species but on *ryukyuensis* it is consistent" (MacNeil, 1960, p. 103).

MacNeil's figure shows a shell allied to *kieneri* by the presence of a bicordate subsutural fold, reminiscent of *cosmoi* in the three heavier spirals of the upper base, but distinct from both in the fewer peripheral gemmules.

Measurements (mm.)—

height	width	
47	15	holotype, USNM 562975.

Synonymy—

1960 *Gemmula granosa ryukyuensis* MacNeil, U. S. Geol. Surv. Prof. Paper 339, p. 103, pl. 14, fig. 24.

*Records—*OKINAWA and Takabananare-shima (Miocene, Yonabaru clay member); Okinawa, Shinzato tuff member (Miocene or Pliocene) (Type locality).

***Gemmula kieneri subspecies
woodwardi* (Martin, 1884)**

(Pl. 188, fig. 2)

*Range—*Indonesia, Pliocene.

*Remarks—*Judging from the original illustration, *Pleurotoma woodwardi* Martin is probably a synonym of *kieneri* Doumet, 1840 (= *granosa* auct.). Both Makiyama, (1927, p. 95) and Nomura (1935, p. 114) concur in this view but since Oostingh (1938, p. 27) makes it a subspecies of "*granosa*," and I have not seen the relevant material, Oostingh's view is accepted for the present.

*Measurements (mm.)—*Size not indicated.

Synonymy—

1884 *Pleurotoma woodwardi* Martin, Samml. Geol. Reichs-Mus., Leiden, Ser. 1, 3, p. 56, pl. 4, fig. 57.

1938 *Turris (Gemmula) granosa woodwardi* Martin, Oostingh, De Ingenieur in Ned-Indie, Gast. 1(7), p. 27.

*Records—*PLIOCENE: deep boring (130 metres) near Batavia, Java Id., Indonesia (type locality); South Bantam, Indonesia, Pliocene (Oostingh, 1938).



Plate 188. Fig. 1, "*Murex (Fusus) granosa*" Helbling (from the original), an indeterminate species. Fig. 2, *Gemmula kieneri woodwardi* (Martin), Pliocene of Sonde, Java, 22.5 mm. (photo courtesy of C. P. Nuttall, Brit. Mus.). Fig. 3, *Gemmula kieneri ryukyuensis* MacNeil. Holotype, Miocene of Okinawa Id., Ryukyu Ids. 47 mm. (from the original, pl. 14, fig. 24).

Gemmula murrayi new species

(Pl. 186, fig. 4)

Range — Persian Gulf.

Remarks — This species stands nearest to *speciosa* (Reeve). It has the same distinctive colour pattern with all the primary spiral cords continuously lined in light-brown on a pale buff ground. It is of smaller adult size and is much narrower than *speciosa* and the peripheral keel is not so prominent.

Description — Adult shell 35 to 40 mm. (about 1½ inches) in height, elongate-fusiform, with a tall spire and long straight canal; spire angle 28° to 30°. Whorls 11-11½, plus a tall narrowly conic axially costate protoconch of 3½ whorls. Spire whorls sculptured firstly with a prominent sub-sutural fold which is narrowly crested by a smooth spiral cord and has two secondary spiral threads both above and below it, three or four smooth spiral cords on the broad, steep and lightly concave shoulder area to the not very prominent gemmate peripheral sinus ridge, which is composed of two closely spaced cords with the gemmules vertically fused, 39-40 on the penultimate. One primary spiral and a few very weak threads present between the peripheral carina and the lower suture. On the upper part of the base there are six rather wide-spaced primary spirals and below, over the neck and canal, there is an alternation of closely spaced primary and secondary spirals. Sinus moderately deep, U-shaped, its apex wider than the peripheral keel. Colour pale creamy buff, the sinus rib and all major spirals lined in light-brown. The main spiral of the subsutural fold is darker brown than any of the other spirals.

Measurements (mm.) —

height	width	
40.0	11.0	holotype
38.0	11.0	
33.0	9.0	

Type Locality — 25° 38' 18" N., 56° 26' 36" E., 73 metres (John Murray Expedition, Sta. 72): off Sharam, west coast of the Gulf of Oman.

Types — The holotype is in the British Museum (Natural History).

Gemmula dampierana new species

(Pl. 186, fig. 5)

Range — North West Australia, the Dampierian Marine Province.

Remarks — This species is closely allied to the preoccupied *Pleurotoma concinna* Dunker, 1856.

Dunker described two species with the specific name *concinna* and confusion later arose through the action of Tryon (1884, p. 335) in combining both species in the synonymy of *reeveana* Deshayes, 1863. Actually, Dunker's two species are very different; that of 1871 in Malak. Blatt. 18, p. 160 is a *Hemidaphne*, and the earlier one, 1856, Proc. Zool. Soc., p. 356, is a *Gemmula*. Dunker's 1856 *concinna* was described from unknown locality but "Andaman Islands" has since been pencilled on the type tablet. This type specimen fits Dunker's description (in Latin) very well, even to the violet staining of the anterior end.

The species name provided above is not a new name for the preoccupied *concinna* but a new proposition for a very constant little *Gemmula* which comes from several dredgings in North West Australia at depths between 46 and 65 fathoms.

This species resembles *murrayi* n. sp. described above but has a wider spire angle, the peripheral gemmules are fewer, the colour pattern is confined to the subsutural fold and to the interstices of the gemmate keel, and the secondary spiral sculpture is stronger.

Nothing exactly matching Dunker's *concinna* is known to the writer, so this preoccupied species is left unnamed until it is rediscovered from some definite locality. A specimen from the Andaman Islands in the United States National Museum, attributed to *concinna*, lacks the overall brown colour and violet stained anterior end, and is in fact inseparable from the South African *gilchristi*.

Description — Adult shell 30 to 35 mm. (about 1¼ inches) in height, elongate-fusiform, with a tall spire and long straight canal. Spire equal to height of aperture plus canal, angle 33° to 35°. Whorls 8, plus a conical protoconch of 3½ whorls, first whorl smooth, remainder axially costate. Spire whorls sculptured firstly with a strong narrowly crested subsutural fold, four crisp spirals on the concave shoulder area, then the prominent gemmate bicarinate peripheral keel, the gemmules vertically fused and numbering 31 or 32 on the penultimate. One strong spiral cord with one or two secondary spirals both above and below it, between the peripheral carina and the lower suture. Upper base with four strong primary cords and one or two intermediates; neck and anterior end with an alternation of closely spaced cords and threads. Sinus deep and narrow, U-shaped, its apex no wider than the peripheral carina. Colour white with the subsutural folds and interspaces of the gemmules on the carina light reddish brown.

Measurements (mm.)—

height	width	
35.5	11.0	holotype
30.7	10.7	

Holotype—Western Australian Museum, Perth.

Records—NORTH WESTERN AUSTRALIA: 7 mi. N.N.W. of Anchor Island, Onslow, 46 fms. (type locality); 10 mi. N.N.W. of Anchor Island, Onslow, 65 fms.; 20 mi. N.W. of Anchor Island, Onslow, 65 fms. (Western Australian-Hawaiian Expedition, 1960).

Gemmula gilchristi (Sowerby, 1902)

(Pl. 189, figs. 1, 2)

Range—South Africa, Zanzibar, Andaman Islands and Japan.

Remarks—This species has been frequently misidentified as *monilifera* Pease, 1860. It was differentiated by Sowerby, 1902, as a new species, *Pleurotoma gilchristi*, a now well-known South African shell.

Description—Adult shell 34 to 37 mm. ($1\frac{1}{2}$ to $1\frac{1}{2}$ inches) in height, elongate-fusiform, with a tall spire and moderately long, slightly flexed anterior canal. Spire greater than height of aperture plus canal; angle 35° to 37° . Adult whorls 9 plus a narrowly conic protoconch of $3\frac{1}{2}$ whorls, smooth at first but strongly axially costate over the last $1\frac{1}{2}$ whorls. Spire whorls with a heavy subsutural fold, a median flange-like gemmate keel and a single strong smooth cord below. The subsutural fold is sharply keeled at the middle and the peripheral or sinus keel is double, densely sculptured with vertically fused gemmules, about 44 on the penultimate. Three interstitial threads between the subsutural fold and the peripheral keel and one in each interspace below the keel. Body whorl with four smooth primary cords below the peripheral keel, number two level with the suture and an alternation of spiral cords and threads over the base. About ten weak closely spaced spirals on the weak anterior fasciole. The whole surface between the spirals is crowded with fine lamellate axial threads. Sinus moderately deep, U-shaped, situated at the termination of the gemmate peripheral keel. Colour uniform golden to light reddish brown for shallow water shells; topotypes (55 fathoms) are whitc, sometimes with pale-brown between the peripheral gemmules.

Measurements (mm.)—

height	width	
34.6	10.7	Kii, Japan
34.0	10.7	Durban
32.5	10.5	Durban
32.0	11.0	holotype
28.7	9.0	Andaman Ids. (USNM)

Synonymy—

1897 *Pleurotoma monilifera* Pease, Sowerby, Append. Marine Shells S. Africa, p. 2 (non Pease, 1860).

1902 *Pleurotoma gilchristi* Sowerby, Marine Invest. in S. Africa, Cape Town, p. 99, pl. 2, fig. 9.

1958 *Turris gilchristi* Sowerby, Barnard, Ann. S. African Mus. 44, p. 106, fig. 3h, 6d.

Types—The holotype is in the British Museum (Natural History).

Records—SOUTH AFRICA: off mouth of Tugela River, 55 fms. (type locality for *gilchristi*); Zululand and Natal Coast, 27 to 90 fms.; off Cape Natal, 185 to 200 fms.; Hood Point, East London, 49 fms. ZANZIBAR: $1\frac{1}{2}$ mi. W.S.W. of Ras Mungwe, 8 fms., fine sand, grass and shell (ANSP). ANDAMAN ISLANDS: (USNM). JAPAN: Kii (USNM).

Gemmula monilifera (Pease, 1860)

(Pl. 189, figs. 3, 4)

Range—Hawaiian Islands and Fiji Islands.



Plate 189. Figs. 1 and 2, *Gemmula gilchristi* (Sowerby), 55 fms., off the mouth of Tugela River, South Africa. 32 mm. Figs. 3 and 4, *G. monilifera* (Pease). Holotype from Brit. Mus. Hawaiian Ids. 29.4 mm. (photo by Alison Kay).

Remarks—This shell is widely known in collections under Dall's manuscript name, *aelomitra*, and in effect this name was legalised in 1952 by the action of Tinker who figured and described the species under Dall's manuscript name in "Pacific Sea Shells," p. 46.

Dall intended *aelomitra* as a new name for the Hawaiian *Turris monilifera* Pease, 1860, which he presumed was preoccupied by *Pleurotoma monilifera* Lea, 1833, an American Eocene species considered by Harris (1937, p. 31) to be synonymous with *Eopleurotoma sayi* (Lea, 1833). Since Pease and Lea described their respective species under different generic names, and each is now located in a different genus, i.e., *Gemmula* and *Eopleurotoma*, there is no name conflict, and *monilifera* Pease, 1860, may stand.

In 1869, Pease again described a *monilifera* but under the genus name *Pleurotoma*; it also is from the Hawaiian Islands and is presumably the same as his 1860 proposition. This point is of no consequence, however, since the 1869 combination is invalidated by Lea's earlier proposition.

Description—Adult shell 22 to 29 mm. (about one inch) in height, narrowly fusiform, with a tall spire and moderately long, almost straight, anterior canal. Spire greater than height of aperture plus canal; angle 25° to 27°. Adult whorls 8 or 9, plus a narrowly conic protoconch of three brown whorls, the first two smooth, the third closely axially costate. Spire whorls with a prominent but narrowly crested subutural fold, followed by a deep shoulder concavity, bearing 3 or 4 crisp spiral threads. Then a heavy peripheral sinus-keel, which is closely studded with two series of gemmules,

vertically fused, resulting in a cog-wheel effect. A single stout smooth spiral cord below the keel and a second one sometimes emergent over the last whorl. Body whorl with four primary smooth cords, followed by weaker cords below, becoming more closely spaced over the neck and anterior end; one or two spiral threads in each interspace. Anal sinus of moderate depth, U-shaped, its apex occupying the full width of the peripheral carina. Colour yellowish to light reddish brown, with the gemmate peripheral keel and the lower base picked out in white.

Measurements (mm.)—

height	width	
29.4	9.5	holotype
28.0	9.0	all off Waikiki, Oahu Id., Hawaii
25.5	8.5	
23.0	7.5	
22.7	7.5	

Synonymy—

1860 *Turris monilifera* Pease, Proc. Zool. Soc., London, p. 398.

1869 *Pleurotoma monilifera* Pease, Amer. Jour. Conch. 5, p. 68 (not of Lea, 1833).

1875 *Pleurotoma (Gemmula) monilifera* Pease, Weinkauff, Jahrb. Deutsch. Malak. Ges. 2, p. 289, pl. 9, figs. 1, 3.

1952 *Turris aelomitra* (Dall, ms.) Tinker, Pacific Sea Shells, p. 46, pl. 1 (lower row).

Types—Pease's holotype is in the British Museum (Natural History). We are indebted to Dr. Alison Kay of Hawaii for its photograph.

Records—HAWAIIAN ISLANDS: "Sandwich Islands," Cuming coll., (type locality); Oahu, off Waikiki, 33-50 fms.; entrance to Honolulu Harbour, 6-8 fms.; entrance to Pearl Harbour, 12-25 fms.; Maui, off Kaanapali; off Mt. Liliu, 4-12 fms. (D. Thaanum coll.); Oahu, off Diamond Head, 100 fms. (P. Burgess). FIJI: Momi Bay, S.E. of Nabilo Light, 13-15 fms. (W. Jennings); "Viti Islands" (A. Garrett, ANSP).

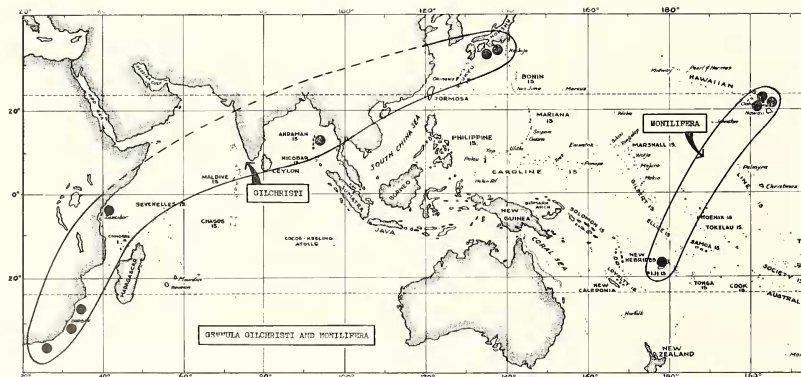


Plate 190. Geographical distribution of *Gemmula gilchristi*

(Sowerby) and *G. monilifera* (Pease).

The Congener Series

Key to the Recent subspecies of *G. congener*

- A. Base with 4 spirals more prominent than the rest
 Shoulder area moderately wide and shallow
 Subsutural fold unicarinate, slight
congener cosmoi
 Subsutural fold bicarinate, slight
congener diomedea
- B. Base with spirals gradually diminishing
 Shoulder area a deep and narrow cleft
 Subsutural fold bicarinate, massive
congener congener

The distributional areas for this group of three Recent subspecies is in the tropical Indian Ocean and Persian Gulf through the East Indies to the Philippines (for *congener congener*); off the Philippines in 100 to 310 fathoms (for *congener diomedea*) and in Japanese waters, 50 to 100 fathoms (for *congener cosmoi*).

Gemmula congener subspecies
congener (E. A. Smith, 1894)

(Pl. 191, figs. 1-4)

Range—East Africa to the Philippines, 100 to 185 fathoms.

Remarks—This subspecies is characterised by the massive development of both the subsutural fold and the peripheral carina. So strongly developed are these two features that the shoulder is reduced to a narrow deep cleft. The spire varies in height between 1.2 and 1.3 times the height of the aperture plus the canal.

Specimens from two John Murray Expedition East African stations in 212 to 310 metres, are beautifully maculated in reddish brown on a white

ground; they are spotted on all the spirals and those between gemmules on the bicarinate periphery are vertically confluent. The specimens are strongly but sparsely lirate within the outer lip and two examples exhibit tubular distortion of basal spirals. This East African maculated form may yet prove to be subspecifically distinct, for it tends also to have a relatively taller spire. The coloration of *congener* from elsewhere is, as in *cosmoi* and *diomedea*, confined to a light-brown band coincident with the subsutural fold.

Description—Adult shell 44 to 63 mm. (1½ to 2½ inches) in height. Post-embryonic whorls 9, rather tightly coiled. Subsutural fold of two strong, densely gemmate, closely spaced spiral ridges. The massive peripheral keel is composed of two closely spaced, densely gemmate, rounded heavy spirals. One or two lesser spirals are between the peripheral carinae and the lower suture, and there are about ten primary spirals on the base, plus intermediate threads which extend densely below over the anterior canal. The primary basal spirals diminish gradually with no especially prominent ones. All of the spirals are rendered gemmate to some degree by the crossing of dense strong axial growth lines. Colour (typically) dull-white except for a light-brown band covering the subsutural pair of cords.

Measurements (mm.)—

height	width	
63.0	18.0	Balayan Bay, Luzon, 159 fms.
56.0	18.0	off Taal, Luzon, 177 fms.
56.0	18.0	off East Africa, 310 metres
55.0	16.2	off East Africa, 310 metres
52.0	17.0	Bay of Bengal, 128 fms. (holotype)
48.5	15.0	Opol, Mindanao, 214 fms.
45.0	16.0	off Colombo, 150 fms.
38.0	13.0	Andaman Islands, 185 fms.

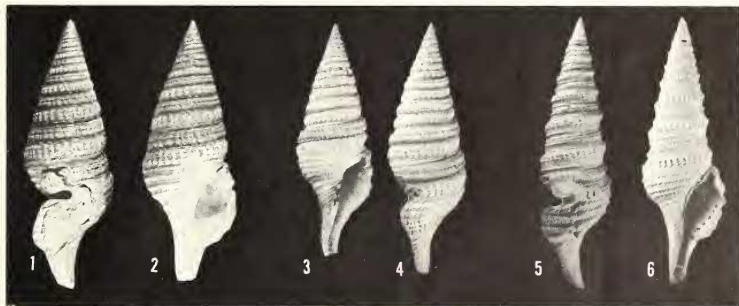


Plate 191. Figs. 1-4, *Gemmula congener congener* (E. A. Smith). Figs. 1, 2, from 150 fms., off Colombo, Ceylon, 45 mm.; figs. 3, 4, from 128 fms., off Arena Point, Luzon Id.,

Philippines, 44 mm. Figs. 5, 6, *Gemmula congener diomedea* new subspecies. Holotype, 256 fms., off Apo Id., Negros Id., Philippines, 73 mm.

Synonymy—

- 1894 *Pleurotoma congener* E. A. Smith, Am. Mag. Nat. Hist., Ser. 6, 14, p. 160, pl. 3, figs. 4, 5.
 1913 *Pleurotoma (Gemmula) congener* Smith, Schepman, Siboga Exped., Pt. 5, 49e, p. 403.
 1917 *Turris (Gemmula) congener* Smith, Melvill, Proc. Malac. Soc. 12, p. 144.

Type—Indian Museum, Calcutta.

Records—PERSIAN GULF (Melvill, 1917). INDIA: Bay of Bengal, 128 fms. (type locality). CEYLON: west of Colombo, 150 fms. (USNM). ANDAMAN ISLANDS: 185 fms. (Investigator Exped., Brit. Mus.). EAST AFRICA: 5° 36' 12" S., 39° 13' 12" E., 310 metres; 5° 38' 54" S., 39° 15' 42" E., 212 metres (John Murray Exped., Brit. Mus.). INDONESIA (Schepman, 1913). PHILIPPINES: off Arena Point, Luzon, 128 fms., Sta. 5382; S.W. of Corregidor Lt., Luzon, 118 fms., mud and shell, Sta. 5272; Tayabas Bay, Luzon, 150 fms., dark green mud, Sta. 5372; Batangas Bay, 170 fms., Luzon, Sta. 5268; off Opol, 214 fms., Mindanao, Sta. 5502; Balayan Bay, 159 fms., Luzon, Sta. 5118 (Albatross Exped., USNM).

*Gemmula congener subspecies
mekranica* (Vredenburg, 1925)

Range—Post-Eocene of India and Miocene of Java and Sumatra.

Remarks—Despite Vredenburg's detailed description, which occupies 4½ pages, there appears to be no obvious differences in his subspecies that are not covered by the normal limits of variation admissible for the Recent species. In his own summary, following the description, Vredenburg (p. 57) states that "Compared with *Pleurotoma congener* this fossil is distinguished by its somewhat smaller dimensions," i.e., as follows: height, 27; width, 10; height of spire, 15; height of body whorl, 16 mm.

Vredenburg (p. 57) then states: "Judging from the figures and descriptions, no essential difference can be discovered between this fossil (i.e. *mekranica*) and a shell from the Upper Miocene of Java and Sumatra which Martin has described as *coronifer(a)* (a name pre-employed by Bellardi in 1877 for a species from the Miocene of Piedmont)."

Vredenburg's figures of his *mekranica* are small and too indistinct for accurate comparison with the living *congener*, so the subspecies is retained tentatively until comparisons of material can be made.

Incidentally, also on page 57, Vredenburg virtually introduces another new name with the following statement "Compared with Mekran specimens, the Gaj specimens are apparently of a still smaller size which, if really characteristic of their horizon, might serve to distinguish them as a variety '*gajensis*.'"

Synonymy—

- 1925 *Pleurotoma (Gemmula) congener mekranica* Vredenburg, Mem. Geol. Surv. India 50(1), p. 54.
 1925 *Pleurotoma (Gemmula) congener gajensis* Vredenburg, Mem. Geol. Surv. India 50(1), p. 57 (nomen nudum).

Records—N.W. INDIA: Gaj of Kachh (Mekran beds, post-Eocene); also west of Gharh Hill and between Kanderi and Sari Dasht in Kulanch, JAVA and SUMATRA: (Upper Miocene) (Vredenburg).

*Gemmula congener subspecies
cosmoi* (Sykes, 1930)

(Pl. 192)

Range—Japan, 50 to 100 fathoms.

Remarks—This shell resembles *kieneri* but is always separable by its loose coiling, or more rapidly increasing whorls, the single subsutural cord, the form of the peripheral gemmules which are not only fused in vertical pairs but extend "comma"-like below the carina, and the prominence of three or four of the basal spirals, as well as the simplicity of the coloration which is white, except for a single spiral light-brown line on the subsutural cord.

The subspecies *diomedea*, described following, indicates the relationship of *cosmoi* to be with *congener* rather than with *kieneri*.



Plate 192. *Gemmula congener cosmoi* (Sykes). 50 fms., off Tosa, Japan. 63 mm.

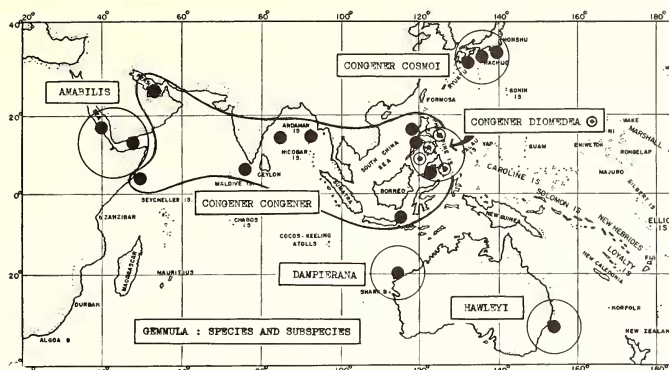


Plate 193. Geographical distribution of *Gemmula congener* and its subspecies, and *Gemmula amabilis* (Weinkauff), *G. hawleyi* Iredale and *G. dampieriana* new species.

Type Locality — Kii, Japan.

Records — JAPAN: Tosa and Kii (ANSP); off Tosa, 50 fms. (USNM); off Tosa, 100 fms. (A. W. B. Powell coll.); Sagami Bay (Thaanum coll.).

Description — Adult shell 52 to 67 mm. (2 to 2½ inches) in height, elongate-fusiform, with a tall spire and long tapered anterior canal. Adult whorls 9, strongly angled by a broad square-faced peripheral carina situated just below the middle of whorl height. This carina is densely studded with laterally compressed cog-like axials which extend a little distance below the carina in comma-like fashion. There is a strong but narrow crested subsutural fold and one, sometimes two, smooth primary cords between the carina and the lower suture. Shoulder with three to four fine crisp secondary spiral threads. Body whorl with three or four spiral cords much stronger than the rest, situated on the upper part of the base. Below this the spirals become weaker and rather crowded over the neck and canal. Colour as described above, pure white, except for a subsutural light-brown line. The whole surface crossed by rather dense but weak axial growth lines which tend to crenulate the primary basal spirals.

Measurements (mm.) —

height	width	
67.0	21.5	
64.0	20.7	
63.0	18.7	
52.0	17.0	
46.5	12.0	holotype

Synonymy —

- 1930 *Turris cosmoi* Sykes, Proc. Malac. Soc. 19, p. 82, text fig.
 1954 *Gemmula cosmoi* Sykes, Kira, Coloured Illust. Shells of Japan, pl. 35, fig. 13.

Gemmula congener subspecies diomedea new subspecies

(Pl. 191, figs. 5, 6)

Range — Philippines, 100 to 350 fathoms.

Remarks — This subspecies forms a link between the delicately sculptured Japanese *cosmoi* and the robust, heavily carinated Indian Ocean *congener*.

So far *diomedea* is known only from deep water off the Philippines. It resembles *congener* in having a bicarinate subsutural fold but the wide shallow shoulder area and the four extra strong basal spirals are characters more in accord with *cosmoi*. The subspecific name is derived from *Diomedea*, the genus for the wandering albatross.

In a number of instances this subspecies exhibits heavy folds and flutings at the termination of the basal primary cords and these strongly lacinate the outer lip margin.

Description — Adult shell 63 to 88 mm. (2½ to 3½ inches) in height, elongate-fusiform, with a tall spire and long considerably flexed anterior canal. Adult whorls 9, strongly angled at about middle whorl height by a broad square-cut peripheral carina which is densely studded with vertically fused gemmules. Subsutural fold composed of two closely spaced gemmate cords. Threads, 3 to 5, on the deeply concave shoulder, 2 primary cords between the peripheral carina and the lower suture with 2 to 3 weak threads in the interspaces. Body whorl including neck and anterior canal with numerous primary cords and intermediate threads.

Four spiral cords on the upper part of the base much stronger than the rest and in some examples these are developed into heavy meandering and twisted folds that laciniate the margin of the outer lip. Spiral sculpture of dense, strong, axial threads which render all the cords gemmate or crenulate. Colour white except for a subsutural band of light-brown which covers both subsutural cords.

Measurements (mm.)—

height	width	
88.0	27.0	Malocot Pt., Luzon Id., 198 fms.
73.0	20.5	holotype
63.3	18.2	paratype
53.6	16.5	off Panglao Id., 220 fms.

Types—The type locality is Albatross Station 5397, 198 fathoms, off Malocot, West Luzon Island, Philippines. The holotype is in the U. S. National Museum, no. 238878.

Records—PHILIPPINES: S.E. of Pt. Tanon, Cebu Id., 310 fms. (Albatross Sta. 5335); N.W. of Panglao Id., 220 fms. (Albatross Sta. 5198); off Dupon Bay, Leyte Id., 350 fms., green mud (Albatross Sta. 5407); off Apo Id., Negros Id., 256 fms. (Albatross Sta. 5538); off Malocot Pt., West Luzon Id., 198 fms., mud and sand (Albatross Sta. 5397); West of Siquijor Id., 254 fms., green mud (Albatross Sta. 5369); off Tayabas Lt., Luzon Id., 106 fms., black sand (Albatross Sta. 5369); off Tayabas Bay, Luzon Id., 190 fms., green mud (Albatross Sta. 5374); off Opol, Mindanao Id., 214 fms. (Albatross Sta. 5501); off Pt. Sella, Mindanao Id., 219 fms. (Albatross Sta. 5541); off Abgao, Leyte Id., 182 fms., green mud (Albatross Sta. 5403); also the following Albatross Philippine stations—5118, 5404, 5410, 5508, 5535 and 5589 (USNM).



Plate 194. Figs. 1, 2, *Gemmula miocoronifera* new name, Miocene of Java. Formerly *Pleurotoma coronifer* Martin, 1879, non Bellardi, 1877 (from K. Martin, 1879, pl. 11, figs. 2, 2a). Figs. 3-5, *Gemmula imitatrix* Martin. Lower or Middle Miocene of Java, Nanggulan Beds. Figs. 3, 4, original types for *Pl. coronifera* Martin, 1884 (not 1879). Fig. 5, syntype of *imitatrix* Martin.

Gemmula miocoronifera new name

(Pl. 194, figs. 1, 2)

Range—Miocene of Liotjijankang, Java Island, Indonesia (type locality).

Remarks—This species is characterised by its tall, narrowly tapered spire and double-submarginating of the suture, the top spiral cord being the smaller. It seems more closely related to *kieneri* (Doumet) than to *congener*, and is certainly not a synonym of Vredenburg's *mekranica*.

The name *Pleurotoma coronifer* Martin, 1879, must be considered as a homonym of *Pleurotoma coronifera* Bellardi, 1877, for there is no proper Latin form "coronifer," only *coronifera*, a fact which Martin realized in 1884 when he corrected his spelling to *coronifera*. I hereby rename Martin's homonym *Gemmula miocoronifera* new name. Martin did not give any measurements in his original description.

Synonymy—

- 1879 *Pleurotoma coronifer* Martin, Tertiärschichten auf Java, p. 61, pl. 2, fig. 2 (non Bellardi, 1877).
 1884 *Pleurotoma coronifera* Martin, Samml. Geol. Reichs-Mus. Leiden, Ser. 1, 3, p. 58 (in part, synonymy only).

Gemmula imitatrix (Martin, 1916)

(Pl. 194, figs. 3-5)

Range—Miocene of Djokdjokarta (Nanggulan), Java Island, Indonesia (type locality).

Remarks—This species is a new name for the same author's *coronifera* of 1884, not *coronifer*, again of the same author, 1879. The species has a wider spire angle and the gemmate keel is less prominent than in the original *coronifera*.

Measurements (mm.)—

height	width
19.0	—

Synonymy—

- 1884 *Pleurotoma coronifera* Martin, Samml. Geol. Reichs-Mus., Leiden, Ser. 1, 3, p. 58, pl. 4, fig. 58 (not of Martin, 1879).
 1916 *Pleurotoma (Hemipleurotoma) imitatrix* Martin, Die altmiocene Fauna des West-Progogebirges auf Java, Samml. Geol. Reichs-Mus., Leiden, 2, p. 229, pl. 1, figs. 13, 13a.
 1938 *Turris (Gemmula) imitatrix* Martin, Oostingh, Die Moll. Plioc. Sud. Bantam in Java, De Ingen. Ned.-Indie, Gast. 1, p. 28.

Gemmula sindiensis (Vredenburg, 1925)

(Pl. 195, figs. 1-3)

Range — Post-Eocene of India.

Remarks — This species, which its author "regarded in all probability as a premutation of *Pleurotoma congner*," is in one important respect dissimilar in that the subsutural fold carries only one spiral cord, which allies it instead with *cosmoi*. The Indian fossil, however, is uniformly more strongly spirally sculptured than the Japanese Recent species, yet does not show a selective development of the three or four upper base spirals so characteristic of *cosmoi*.

Measurements (mm.) —

height	width	height of spire	height of body whorl
27	10	16	16

Synonymy —

1925 *Pleurotoma (Gemmula) sindiensis* Vredenburg, Mem. Geol. Surv. India 50(1), p. 58, pl. 5, figs. 13, 14.

Records — N.W. INDIA (post-Eocene): Gaj of Kachh, near Warsaw, north of Jakao.

Gemmula pulchella Shuto, 1961

(Pl. 195, figs. 4, 5)

Range — Lower Pliocene of Japan.

Remarks — This shell was described as a subspecies of *granosa* Helbling (i.e. *kieneri* Doumet) but from figures and the description the alliance seems to be with *cosmoi* Sykes. It is described as having a very small protoconch, 22 gemmules on the penultimate whorl and 29 on the body whorl, and an anal sinus that is broader than the carina, but Shuto's figure (text fig. 4, no. 3) shows a sinus restricted to, if not narrower than, the carina. In *cosmoi* the gemmules range from 25 to 32 and in *kieneri*, 30 to 35 per whorl.

Although the type of *pulchella* is a small shell, only 10.2 mm. in height, it has six adult whorls and is evidently approaching full size. It can be assessed as a forerunner of *cosmoi* characterised by a dwarf size and fewer, stronger gemmules.

Measurements (mm.) —

height	width
10.2	5.6

Synonymy —

1961 *Gemmula granosa pulchella* Shuto, Mem. Fac. Sci. Kyushu Univ. Ser. D, Geol. 11(2), p. 80, pl. 10, figs. 1, 2; text figs. 3, 4.

Records — JAPAN (middle part of Takanabe member, Lower Pliocene): roadside small cliff at Nihonmatsu, Takanabe machi, Koyu gun, Miyazaki Prefecture.

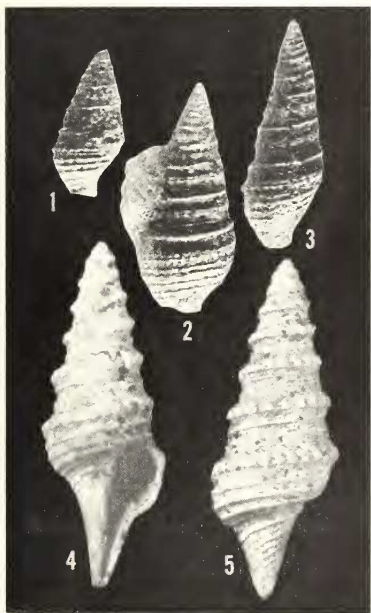


Plate 195. Figs. 1-3, *Gemmula sindiensis* (Vredenburg). Gaj of Kachh, India, Post-Eocene. Figs. 4, 5, *Gemmula pulchella* Shuto. Lower Pliocene, Takanabe member, Japan (both holotypes from the original figures).

[These occasional blank areas occur between genera and subgenera to permit the insertion of new material and future sections in their proper systematic sequence.]

The Martini Series

Gemmula martini (Tesch, 1915)

(Pl. 196, figs. 1-4)

Range—Pliocene of Timor; Recent, off East Africa and off Borneo in deep water.

Remarks—This species along with *aethiopica* Thiele, *sibogae* Schepman and *sibukoensis* form a group characterised by the peripheral carina set low on the spire whorls, almost at the lower suture, which results in a rather flat-sided profile to each whorl in the spire.

Description—Adult shell 46 to 77 mm. (about 2 to 3 inches) in height, solid, broadly fusiform, uniformly dull-white, without colour markings. Adult whorls 11, outlines straight except for a slightly projecting, broadly rounded sinus-rib set just above the lower suture. Sculpture simple, of smooth narrowly rounded but relatively strong spiral cords. Above the peripheral carina the interspaces are without interstitial spirals but below the carina, over the base, neck and canal, all the cords have one or two spiral threads between them. The peripheral carina is composed of 2 or 3 closely spaced spiral cords which are densely studded with vertically and partially fused gemmules, 38 to 50 per whorl. Spire equal to height of aperture plus canal, angle 35° to 37° .

Measurements (mm.)—

height	width	
77.0	25.0	East Africa, 638 metres (type of <i>valdiviae</i>)
68.0	22.5	Sibuko Bay, Borneo, 310 fms.
49.0	16.0	Timor, Noil Aintie (Pliocene)
48.0	16.5	type of <i>martini</i> (fig. 48b of Tesch)

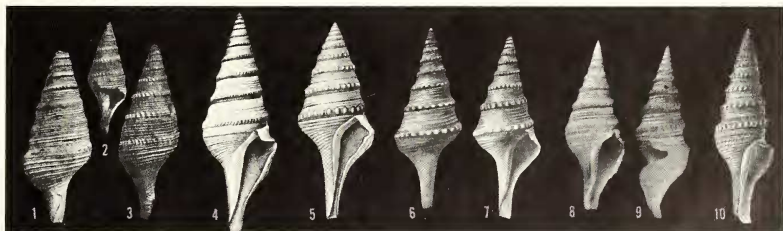


Plate 196

Figs. 1- 3 *Gemmula martini* (Tesch). Pliocene of Timor. Tesch's original figures, pl. 77.

4 *Gemmula martini* (Tesch). Holotype of *Pleurotoma (Gemmula) valdiviae* (Thiele), off East Africa (from Thiele, 1925, pl. 23, fig. 1).

5 *Gemmula aethiopica* (Thiele). Holotype. 638 metres, off East Africa (from Thiele, 1925, pl. 34, fig. 25).

6, 7 *Gemmula sibogae* Schepman. Holotype. 472

Synonymy—

1903 *Pleurotoma (Gemmula) carinata* Gray, Martens, Gast. Deutsch. Tiefsee-Exped., p. 76 (non Griffith & Pidgeon, 1834).

1915 *Pleurotoma* (s.str.) *martini* Tesch, Palaeont. von Timor, p. 26, pl. 77(5), figs. 48, 49.

1925 *Pleurotoma (Gemmula) valdiviae* Thiele, Wissenschaft. Ergebn. Deutschen Tiefsee-Exped., 17, Gastr. 2, p. 208, pl. 23, fig. 1.

Types—The type locality for *martini* (Tesch) is in a Pliocene deposit, station W III, Noil Noni, between Kapan and Niki-Niki, Timor, Indonesia.

Records—TIMOR: (Pliocene) Noil Noni (type locality of *martini*); Noil Aintie, Kolo, Pliocene (Brit. Mus.). EAST AFRICA: off Somaliland, $0^{\circ} 27.4' S.$, $42^{\circ} 47.3' E.$, 638 metres (type locality of *valdiviae*); off Somaliland, 977 and 1134 metres (Thiele, 1925). SUMATRA: off north coast, $6^{\circ} 56.3' N.$, $93^{\circ} 32.7' E.$, 362 metres; off Nias Id., 470, 614 and 660 metres (Thiele, 1925). BORNEO: S.E. of Mabul Id., Sibuko Bay, grey mud and sand (Albatross Sta. 5590, USNM).

Gemmula aethiopica (Thiele, 1925)

(Pl. 196, fig. 5)

Range—Off Somalia, East Africa, 638 metres.

Remarks—From its figure and description this species appears to be closely allied to *martini* Tesch but has sufficient differences to warrant specific separation from that species. Compared with *martini*, the shoulder is not so straight in profile but is inwardly subangled medially by a groove that delimits a broad but flat subsutural collar. The gemmules are fused into oval shapes taller than wide and set across the tricordate peripheral carina. These gemmules are much stronger but less numerous than in *martini*. None of the spiral cords, not even those on the base, appear to have intermediate spirals.

metres, between Makjan and Halmahera Ids., Indonesia (from Schepman, 1913, pl. 26, fig. 2).

8, 9 *Gemmula sibukoensis* new species. 310 fms., S.E. of Mabul Id., Sibuko Bay, Borneo. Fig. 8 is holotype, 46.2 mm.

10 *Gemmula vagata* (E. A. Smith). Holotype. 200-350 fms., off Trincomalee, Ceylon (from E. A. Smith, 1895, pl. 1, fig. 3).

Measurements (mm.)—

height	width
47	19

Synonymy—

1925 *Pleurotoma* (*Gemmula*) *aethiopica* Thiele, Wissenschaft. Ergebn. Deutschen Tiefsee-Exped., 17, Gastr. 2, p. 208(174), pl. 34(22), fig. 25.

Types—The type locality is off East Africa, Valdivia Sta. 253, 0° 27.4' S., 42° 47.3' E., 635 metres, off southern Somalia.

Gemmula sibogae (Schepman, 1913)

(Pl. 196, figs. 6, 7)

Range—Indonesia, between Makjan and Halmahera, 472 metres.

Remarks—Compared with *aethiopica*, the spire angle is much less, the peripheral gemmules appear to be stouter and rather fewer per whorl, and the base more suddenly contracted. The coloration is described as whitish, faintly yellowish on the keel, between the nodules. The spire angle judged from figures is 42° in *aethiopica* but only 33° in *sibogae*.

Measurements (mm.)—

height	width
27.5	11.5

Synonymy—

1913 *Pleurotoma* (*Gemmula*) *sibogae* Schepman, Siboga Exped., Pt. 5, 49e, p. 404, pl. 26, fig. 2.

Types—The type locality is Indonesia, Siboga Sta. 137, channel between Makjan and Halmahera, fine dark muddy sand, 472 metres.

Gemmula sibukoensis new species

(Pl. 196, figs. 8, 9)

Range—Borneo, Moluccas and Philippines, 50 to 484 fathoms.

Remarks—This is another member of the group with the peripheral carina set low down on the spire whorls. It appears nearest to *sibogae* Schepman, but differs in having a heavier peripheral carina a little above the lower suture, allowing the emergence of the uppermost basal spiral over the later whorls, and the shape of the body whorl, which is but slowly contracted over the base to a shorter and flexed, not straight canal.

Description—Adult shell 41 to 48 mm. (about 2 inches) in height. Fusiform, with a tall spire, about 1 1/5 times height of aperture, plus canal. Whorls 10, plus a small polygyrate conic protoconch of 3 whorls or more, the last, at least, axially costate. Protoconch eroded and the tip missing in

all available specimens. Spire whorls turreted by a strong rather broadly rounded peripheral sinus-rib, which is set low on the whorls, almost at the lower suture, but with a narrow space beneath it, which allows the emergence, over the last few whorls, of the uppermost basal spiral. Peripheral sinus-rib densely sculptured with laterally compressed, concavely arcuate axials, 27 to 31 per whorl, overridden by 2, occasionally 3, weak spirals. Spiral sculpture consisting of rather strong but narrow cords, 3 to 5 on the wide, steeply descending shoulder and 16 to 18 on the base; 3 on the upper part of the base rather stronger than the rest, which diminish in size gradually to the end of the anterior canal. Labial sinus of moderate depth, V to U-shaped, its apex wider than the crest of the sinus-rib. Colour creamy white. Surface crossed by dense sharp axial growth lines.

Measurements (mm.)—

height	width	
47.8	16.2	figured paratype
46.2	16.2	holotype

Types—The type locality is Albatross station 5590, S.E. of Mabul Island, Sibuko Bay, Borneo, in 310 fathoms. The holotype is in the United States National Museum, no. 239111.

Records—BORNEO: S.E. of Mabul Id., Sibuko Bay, 310 fms. (holotype) (Albatross Sta. 5590); off Mabul Id., Sibuko Bay, 260 fms., sandy mud (Albatross Sta. 5589); off Sihungan Id., Sibuko Bay, 305 fms., green mud and sand (Albatross Sta. 5592). CELEBES: Gulf of Boni, 484 fms., grey mud (Albatross Sta. 5656); MOLUCCAS: off Kayoa Id., 265 fms., grey mud and fine sand (Albatross Sta. 5626); off Makyan Id., Molucca Pass, 288 fms., fine sandy mud (Albatross Sta. 5624). PHILIPPINES: off Liangan River, Mindanao Id., 410 fms., grey mud and sand (Albatross Sta. 5511); N. of Biliran Id., 50 fms., mud and sand (Albatross Sta. 5210) (all USNM).

Gemmula vagata (E. A. Smith, 1895)

(Pl. 196, fig. 10)

Range—Indian Ocean from Aden to the Andaman Islands, in deep water.

Remarks—This very distinctive species is at once recognised by its almost vertical-sided whorls between a strongly projecting flange-like peripheral keel.

Description—Adult shell 60 to 65 mm. (about 2 inches) in height, rather heavily built and strongly sculptured. Spire tall and narrow with rather straight and almost vertical sides, interrupted just below the middle by a prominently projecting, heavy, flange-like, gemmate keel. Spire 1.2 to 1.3 times height of aperture plus anterior canal. The sculpture of the spire whorls consists of a moder-

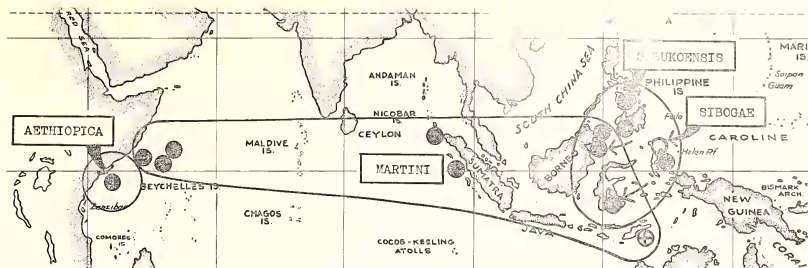


Plate 197. Geographical distribution of *Gemmula athiopica* (Thiele), *G. martini* (Tesch), *G. sibogae* (Schepman) and *G. sibukoensis* new species.

ately strong subsutural square-cut fold, bearing 2 spiral cords, with 2 or 3 fine spiral threads between them, followed by a deeply concave shoulder, bearing 5 to 9 weak spiral threads between the subsutural fold and the strongly gemmate cog-like peripheral sinus-rib. About 24 gemmules on the penultimate. Below the peripheral sinus-rib, 2 of the basal series of plain narrow spirals are emergent. About 16 to 18 basal spirals present, those above wide-spaced and with several fine threads in each interspace. Colour (Smith, 1904) "The infra-sutural keel is generally somewhat reddish and the central carina is spotted with the same colour between the tubercles."

The species seems to be nearest allied to *gemmulina* Martens, a smaller and less solid shell from the Archibenthal of Indonesia and the South China Sea.

Measurements (mm.)—

height	width	
65.0	23.0	Ceylon, 200 to 350 fms. (type)
61.0	18.0	Chagos Archipelago, 494 metres
53.0	17.0	Chagos Archipelago, 494 metres
46.0	15.0	Gulf of Aden, 1022 metres

Synonymy—

- 1895 *Pleurotoma vagata* E. A. Smith, Ann. Mag. Nat. Hist., Ser. 6, 16, p. 3, pl. 1, fig. 3; 1904, E. A. Smith, Ann. Mag. Nat. Hist., Ser. 7, 13, p. 456.
1909 *Pleurotoma vagata* Smith, Annandale & Stewart, Illustr. Zool. Investigator, Calcutta, Moll., 6, pl. 14, figs. 3, 3a.

Types—Indian Museum, Calcutta.

Records—CEYLON: off Trincomalee, 200-350 fms. (type locality). INDIA: off Travancore coast, 360 fms. (Smith, 1904); off Malabar coast, 295-360 fms. (USNM); GULF OF ADEN: 732 metres, 1022 metres and 1061 metres, 4° 58' 42" S., 73° 16' 24" E., north of the CHAGOS ARCHIPELAGO, 494 metres (John Murray Exped.) (Brit. Mus.). ANDAMAN ISLANDS: 185 fms. (Smith, 1904).

Gemmula praesignis (E. A. Smith, 1895)

(Pl. 198, fig. 1)

Range—Off Colombo, Ceylon, 675 fathoms.

Remarks—Smith's species, based presumably upon a single imperfect shell minus the protoconch as well as the tip of the anterior canal, does not look very different from that author's *vagata*, described in the same paper from approximately the same area; deep water off Ceylon. From the figure, *praesignis* would appear to differ from *vagata* in having a heavier peripheral carina with more prominent and less numerous nodules, a very strong sharply crested subsutural spiral and fewer secondary spirals in the shoulder concavity.

Description (E. A. Smith)—"The prominent row of tubercles around the middle of the whorls, the keel beneath the suture, and the broad sinus in the labrum are the principal features of this species. The apex of the spire being broken away makes it impossible to state with certainty the exact number of whorls, but they would probably amount to eleven or twelve. The entire surface exhibits fine flexuous lines of growth."

Measurements (mm.)—

height	width	
42.0	15.0	holotype

Synonymy—

- 1895 *Pleurotoma praesignis* E. A. Smith, Ann. Mag. Nat. Hist., Ser. 6, 16, p. 4, pl. 1, fig. 4.

Types—Indian Museum, Calcutta.

Records—CEYLON: off Colombo, 675 fms. Schepman, 1913, Siboga Exped., Moll., p. 39, recorded this species from the Flores Sea in 794 metres and Hahmhera Sea in 411 metres, but both records are suspect since they were based upon "very young" specimens.

Gemmula ducalis (Thiele, 1925)

(Pl. 198, fig. 2)

Range—Off East Africa, 1134 metres.

Remarks—This juvenile shell is only 6 mm. in

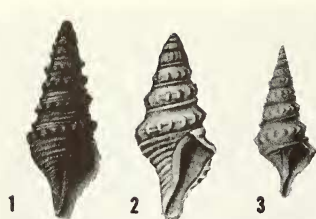


Plate 198. Fig. 1, *Gemmula praesignis* (E. A. Smith). Holotype. 675 fms., off Colombo, Ceylon (from E. A. Smith, 1895, pl. 1, fig. 4). Fig. 2, *Gemmula ducalis* (Thiele). Holotype. 1,134 meters, off Somaliland, East Africa (from Thiele, 1925, pl. 23, fig. 2). Fig. 3, *Gemmula rotatilis* (Martens). Holotype. 1,134 meters, off Somaliland, East Africa (from Martens, 1903, pl. 1, fig. 3).

height, and consists of a typical multispiral, axially costate protoconch and three post-nuclear whorls. It is impossible to say at this stage of our knowledge of the genus if this is really a distinct species or merely a juvenile of one already described.

Synonymy —

1925 *Pleurotoma* (*Gemmula*) *ducalis* Thiele, Wissenschaft. Ergebn. Deutschen Tiefsee-Exped., 17, Gastr. 2, p. 209, pl. 23, fig. 2.

Records — Off Somaliland, East Africa, 1° 49' N., 45° 29.5' E., 1,134 metres.

Gemmula gemmulina (Martens, 1902)

(Pl. 200, fig. 2; pl. 201, figs. 1, 2)

Range — Sumatra to China Sea and the Philippines, 35 to 505 fathoms.

Remarks — The Albatross Expedition material recorded below is claimed with some confidence to represent von Marten's species, the type of which came from off the west coast of Sumatra in 677 metres.

Nothing quite matching *gemmulina* in sculptural detail was found although the Albatross material exhibits a considerable range of sculptural variation. It is possible, of course, that von Marten's figure is over-simplified so far as secondary sculpture is concerned.

A characteristic feature, however, is common to both von Marten's figures and the Albatross specimens and that is the strong crisp nature of the bicarinate subsutural fold.

The discrepancy noted above concerns the subsidiary spirals on the concave shoulder between the subsutural fold and the peripheral carina. In von Marten's figure only one, quite distinct, spiral appears in the shoulder concavity but in the Albatross material these spirals number from 3 to 5,

of which never more than 3 are relatively strong. Since there is such variation in a series of 7 Albatross specimens from 5 localities it is likely that a wider series would include such an example as Marten's type within the range of variation admissible for the species.

The species shows relationship with *vagata* (Smith), which differs in having almost vertical-sided whorls, a longer canal, a weaker bicarinate subsutural fold and weaker secondary sculpture, as well as attaining a larger adult size.

Description (based upon the figured Molucca Passage shell) — Adult shell 29 mm. (1 1/8 inches) in height, solid, white, covered by a thin shining light creamy-buff periostracum. Pagodiform, with a tall spire and relatively short anterior canal. Spire about 1.3 times height of aperture plus canal. Adult whorls 10 (protoconch worn in all specimens but indicated as tall, polygyrate and axially costate). Sculptured with two closely spaced crisp spiral cords forming the subsutural fold, a prominent gemmate bicarinate peripheral keel below the middle of whorl height and subsidiary spiral cords, 3 between the subsutural fold and the peripheral keel and 2 to 3 below it. Base with about 17 subequal primary cords and a single weak thread in each interspace over the region of the neck. The peripheral gemmules are vertically fused into laterally compressed nodes giving a cog-wheel effect. The nodes number 20 on the penultimate. Sinus openly U-shaped, not very deep, its apex rather wider than the peripheral keel. The whole surface of the shell crossed by regular thin axial growth threads.

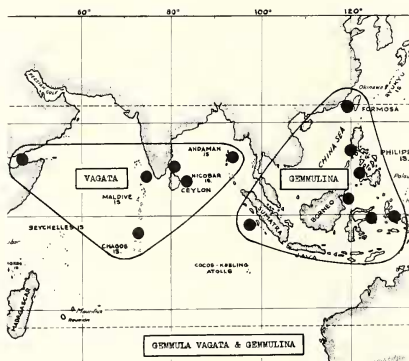


Plate 199. Geographical distribution of *Gemmula vagata* (E. A. Smith) and *G. gemmulina* (Martens).

An extreme variant from 90 fathoms off Luzon Island has a very prominent bicarinate subsutural fold and 5 spiral cords in the shoulder concavity.

Measurements (mm.)—

height	width	
37.5	12.0	Pratas Id., China Sea, 122 fms.
35.7	11.7	Luzon Id., 90 fms.
29.0	10.2	Molucca Passage, 275 fms.
27.0	9.2	Molucca Passage, 230 fms.
23.2	8.0	Molucca Passage, 230 fms.
20.5	6.3	type

Synonymy—

1902 *Pleurotoma (Gemmula) gemmulina* Martens, Sitzungsber. d. Gesell. naturf. Freunde, Berlin, p. 238; 1903 Martens, Gast. der Deutsch. Tiefsee-Exped., 1898-1899, 7, p. 77, pl. 1, fig. 2.

Records— SUMATRA: off west coast, 677 metres (type); off Siberut Id., 750 metres (von Martens). MOLUCCAS: off Makyan Id., Molucca Passage, 275 fms. grey mud, Sta. 5622; off Gillolo Id., Molucca Passage, 230 fms., Sta. 5625. CELEBES: S.E. of Tikola Peninsula, Buton Strait, 37 fms., grey mud, Sta. 5642. BORNEO: S. of Silungan Id., Sibuko Bay, 305 fms., Sta. 5592. CHINA SEA: off Pratas Id., 122 fms. PHILIPPINES: off Cape Santiago, Luzon Id., 280 fms., Sta. 5283; off Pitogo, Luzon Id., 90 fms., grey mud and sand, Sta. 5376; N. of Ambil Id., 102 fms., fine sand and mud, Sta. 5278; Iligan Bay, N. Mindanao Id., 505 fms., grey mud and fine sand, Sta. 5513 (all Albatross stations, USNM).

Gemmula amabilis (Weinkauff, 1875)

(Pl. 200, fig. 1; pl. 201, figs. 3-7)

Range— Red Sea.

Remarks— So far as can be judged from Weinkauff's very sketchy figures of his species and the more detailed figures of Sturany, 1903, presumably the same species, the deep-water John Murray Expedition series of specimens from 732 metres off Aden may at present be considered conspecific. The John Murray specimens are more elongate and when compared with authentic *amabilis* material, may prove to be a bathymetric form of that species, which was probably from shallow water.

Description (Weinkauff, 1875, p. 29)—“Testa fusiformis, solidiuscula, pallide flavefusca, spiralleri cingulata, interstitiis sublente striis incrementi sculpta, cingula una valida, distincte nodosa, carinam distinctam efficiens, noduli albide picti: spira elato-conica, apice acuto, anfractibus 11, unicarinatis, sutura evanescente obliqua divisi, ultimus convexus, canali longo productus; apertura verticalis piriformis, intus sublente costata, margine externo basi producto (Jickeli). Long 18 diam. maj. 6, apert. 4 mm.” (See our pl. 201, figs. 3-5).

Description (based upon Aden, 732 metres example)—Adult shell 20 to 26 mm. ($\frac{3}{4}$ to 1 inch) in height, elongate-fusiform with a tall spire whose angle is 26° to 27° , and with a moderately long-flexed anterior canal. Whorls 9, plus a tall narrowly conic protoconch of $3\frac{1}{2}$ whorls, first 2 whorls smooth, remainder strongly axially costate. Post-nuclear whorls sculptured with a relatively strong tricardate subsutural fold, the central cord strongest and forming a sharp keel. Shoulder concavity with three crisp spiral threads, followed by a prominent bicarinate gemmate flange which is located a little below the middle of the whorl. Gemmules vertically fused into laterally compressed nodes, 18 on the penultimate. A single smooth cord and a weak thread are above it between the peripheral carina and the lower suture. Body whorl with three strong smooth widely spaced cords above, below which are 13 finer, closely spaced cords and a similar weaker number over the anterior end. Sinus a broadly open shallow “U,” its rounded apex occupying the full width of the peripheral carina. Colour uniformly white.

Measurements (mm.)—

height	width	
24.0	7.6	off Aden, 732 metres
18.0	6.0	off Aden, 732 metres
18.0	6.0	type, Massana, Red Sea



Plate 200. Fig. 1, *Gemmula amabilis* (Weinkauff), 732 meters, in the Gulf of Aden, 18 mm. Fig. 2, *Gemmula gemmulina* Martens, 275 fms., off Makyan Id., Molucca Passage, Albatross station 5622, 29 mm. Fig. 3, *Gemmula graeffei* (Weinkauff), Momi Bay, south of Nabilo Light, Fiji, 22 mm. Fig. 4, *Gemmula hombroni* Hedley, Cebu Id., Philippines, 26 mm.

Synonymy —

1875 *Pleurotoma amabilis* (Jickeli ms.) Weinkauff, Conch. Cab. 4(3), p. 29, pl. 6, figs. 4, 6.

1875 *Pleurotoma (Gemmula) amabilis* (Jickeli ms.) Weinkauff, Jahrb. Mal. Ges. 2, p. 291, pl. 9, figs. 6, 8.

1903 *Pleurotoma (Gemmula) amabilis* Weinkauff, Sturany, Gast. des Rothen Meeres, Exped. S. M. Schiff "Pola," pl. 3, fig. 3 a-c.

Records — RED SEA: Massana (type locality); Gulf of Aden, 732 metres (John Murray Exped. Sta. 176, Brit. Mus.).

Gemmula hombroni (Hedley, 1922)

(Pl. 200, fig. 4; pl. 201, fig. 8)

Range — Andaman Islands and Indonesia to the Philippines, and Japan to northern Australia.

Remarks — This small, slender, uniformly reddish-brown shell is one of the most distinctive of the genus. It has long been recognised under the pre-occupied name of *fusca* Hombrón & Jacquinot, but some confusion has occurred through Tryon's (1884) action in erroneously uniting it with *gemmata* Hinds, the Lower California–Panamic type of the genus.

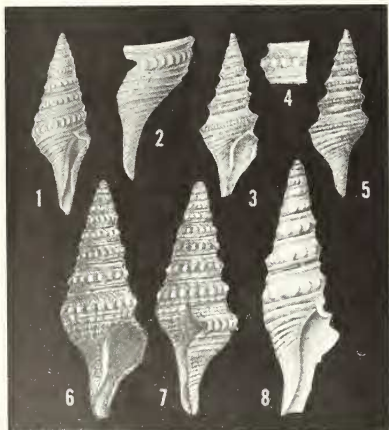


Plate 201. Figs. 1, 2, *Gemmula gemmulina* (Martens) (also see pl. 200, fig. 2), 677 metres, off the west coast of Sumatra (from Martens, 1902, pl. 2, figs. 2, 2a). Figs. 3-5, *Gemmula amabilis* (Weinkauff), Massana, Red Sea (from Weinkauff, 1875, pl. 9, figs. 6, 8). Figs. 6, 7, *G. amabilis* (Weinkauff), Red Sea, (from Sturany, 1903, pl. 3, fig. 3). Fig. 8, *Gemmula hombroni* (Hedley), Padang, Sumatra (holotype of *Pleurotoma padangensis* Thiele, original pl. 23, fig. 5).

Description — Adult shell 25 to 27 mm. (about 1 inch) in height, elongate-fusiform, with a tall slender spire and long slightly-flexed anterior canal. Whorls 8 to 8½, exclusive of a tall, narrowly conic, polygyrate protoconch of 3½ to 4 whorls, all but the tip sculptured with concavely-arcuate, stout axials. Adult whorls very strongly and definitely sculptured, firstly by a heavy, smooth, narrowly crested subsutural cord, followed by the flange-like, gemmate peripheral sinus-rib, set below the middle of whorl-height, and finally a single heavy, smooth spiral cord, uppermost of the basal series and emergent between the peripheral carina and the lower suture. Base with about 9 rather wide-spaced, strong, flat-topped spiral cords to about the middle of the neck, after which the spirals rapidly diminish in size and become more closely spaced. The concave shoulder area is encircled by 3 to 5 spiral threads. Spire a little taller than height of aperture plus canal, angle 22° to 25°. Gemmules confined to the peripheral carina, 18 to 22 per whorl, smooth, laterally compressed and cog-like. Sinus at periphery moderately deep, U-shaped. Colour uniform, yellowish brown to reddish brown.

Measurements (mm.) —

height	width	
28.0	8.5	Cavite, Manila Bay, Philippines
27.0	7.5	Cavite, Manila Bay, Philippines
25.5	7.0	Cavite, Manila Bay, Philippines
11.5	2.4	type of <i>padangensis</i>

Synonymy —

1853 *Pleurotoma fusca* Hombrón & Jacquinot, Voy. Pole sud, Zool., 4, p. 111, pl. 25, figs. 19, 20 (non *Pl. fusca* C. B. Adams 1845).

1884 *Pleurotoma gemmata* Hinds, Tryon, Manual of Conch. 6, p. 173 (in part).

1913 *Pleurotoma (Gemmula) fusca* H. & J., Schepman, Siboga Exped. 49e, p. 402.

1922 *Gemmula hombroni* H. & J., Hedley, Rec. Aust. Mus. 13(6), p. 218, nom. nov. for *Pl. fusca* Hombrón & Jacquinot, 1853, non C. B. Adams 1845.

1925 *Pleurotoma (Gemmula) padangensis* Thiele, Wissenschaft. Ergebn. Deutschen Tiefsee-Exped., 17, Gastr. 2, p. 335, pl. 23, fig. 5.

Records — AUSTRALIA: Torres Strait (type of *fusca*). PHILIPPINES: Mariveles, Bataan, Luzon Id.; ½ mi. off Bahibatkan, Papapas bay, Batangas Province, Luzon Id., 4 fms.; 1 mi. E. of Limey, Bataan, Luzon Id., 9-10 fms.; 3 mi. E.N.E. of San Nicolas Shoals Light, Manila Bay, Luzon Id., 10 fms.; ½ mi. off Matabunkay Beach, Batangas Province, Luzon Id., 3-4 fms.; ½ mi. E. of Cabaoben, S.E. Bataan, Luzon Id., 2 fms. (duPont-Acad. Exped., 1958, ANSP); N. of Corregidor Id., 37 fms. (Albatross Sta. 5109); Opol, Mindanao Id., (USNM); near Cavite, Manila Bay (MCZ). JAPAN: Yenosima (USNM). ANDAMAN ISLANDS: (USNM). SUMATRA: Padang (type of *padangensis*). Schepman (1913) records the species from 20 Indonesian stations, 9-522 metres, and off western New Guinea, 32 metres.

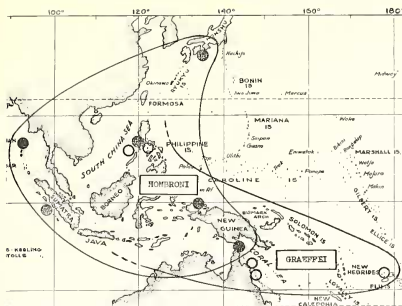


Plate 202. Geographical distribution of *Gemmula hombroni* (Hedley) in solid dots, and *Gemmula graeffei* (Weinkauff) in open circles.

Gemmula graeffei (Weinkauff, 1875)

(Pl. 200, fig. 3)

Range — Fiji, Queensland and Philippines.

Remarks — This species stands nearest to *monilifera*, from which it differs in the spire's height being approximately equal to that of the aperture plus canal, the more slowly contracted base, heavier tricarinate subsutural fold and absence of a zoned colour pattern.

Description (based upon a topotypic specimen) — Adult shell 19 to 22 mm. (about $\frac{3}{4}$ inch) in height, elongate-fusiform with a tall spire and long, slightly flexed anterior canal. Whorls 8, exclusive of a tall, conical, polygyrate protoconch of 3 to $3\frac{1}{2}$ axially costate whorls. Spire equal to height of aperture plus canal; angle about 30° . Spire whorls with a massive subsutural fold crossed by 3 spiral cords, the central one forming a narrowly crested keel. A moderately deep concavity bearing 2 spiral threads separates the subsutural fold from the peripheral keel which is flange-like and composed of 2 strong gemmule cords. The gemmules are fused vertically into laterally compressed nodules. These nodules, which are cog-like, number 25 on the penultimate whorl. A single strong spiral cord between the peripheral carina and the lower suture with a second cord subemergent toward the termination of the last whorl. Base long and very slowly contracted, crossed above by 4 strong smooth spiral cords, the second of which is in line with or a little above the top of the aperture. Wider-spaced primary cords over the neck, with 2 threads in each interspace and about 16 gradually reduced threads over the anterior end. Entire surface between the

spirals with dense, crisp axial threads. Sinus deep, narrow, U-shaped, its apex occupying the full width of the peripheral carina. Colour uniformly light-buff.

Measurements (mm.) —

height	width	
22.0	7.0	Momi Bay, Fiji
21.0	7.0	Pagapas Bay, Philippines
20.0	6.0	type
19.5	5.0	Pagapas Bay, Philippines

Synonymy —

1875 *Pleurotoma* (*Gemmula*) *graeffei* Weinkauff, Conch. Cab. 4(3), p. 71, pl. 3, figs. 9, 10; 1875, Jahrb. deut. malak. Ges. 2, p. 290, pl. 9, figs. 9, 10.

1884 *Pleurotoma* (*Gemmula*) *graeffei* Weinkauff, Tryon, Manual of Conch. 6, p. 173.

Records — FIJI: (type locality); Momi Bay, S. of Nabilo Light, 13-15 fms. (W. Jennings). QUEENSLAND: Low Isles, off Port Douglas; Cairns Reef, 5-8 fms. (Austr. Mus.). PHILIPPINES: $\frac{1}{2}$ mi. off Balibatan, Pagapas Bay, Batangas Province, Luzon Id., 4 fms.; 1 mi. E. of San Nicolas Shoals Light, Manila Bay, Luzon Id., 10 fms.; E. side Jagoliao Id., N.W. end Bohol Id., 12-24 ft.; E. end of Sisman Bay, Batangas, Luzon Id., 8 fms.; E. end of Corregidor Id., Manila Bay, 4 fms. (duPont-Acad. Exped., 1958, ANSP).

The species has been recorded from a wide range of localities but all require personal re-examination.

Gemmula hawleyi (Iredale, 1931)

(Pl. 203)

Range — New South Wales, Australia.

Remarks — This is the only known temperate water occurrence of this otherwise tropical genus. Iredale (1931, p. 226) introduced this species as the type of a new genus, *Eugemmula*, claiming that it differed from the West American type of *Gemmula*, which was stated to have a longer canal and a different apex. These alleged differences, however, prove to be too slight to warrant even subgeneric recognition.

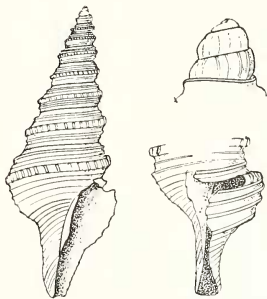


Plate 203. *Gemmula hawleyi* (Iredale), Port Jackson, New South Wales, Australia (from Laceron, 1954, pl. 1, figs. 5-7).

The species *hawleyi* belongs to the group of *monilifera*, *graeffei* and *hombrovi* and is in fact doubtfully distinct from the first mentioned species.

Too few examples, all dead shells, are known to afford a critical comparison at present, but if a topotype in the writer's collection proves a constant criterion for the species, then it is distinguished from *monilifera* by having two cords between the periphery and the lower suture, with a third sub-emergent over the last half whorl. Although all examples known to the writer are dead shells there are traces of a zoned colour pattern typical of that found in *monilifera*.

Measurements (mm.)—

height	width	
35.0	12.0	type of <i>hawleyi</i> Iredale
21.2	7.5	Port Jackson, Sydney

Synonymy—

- 1931 *Eugemmula hawleyi* Iredale, Rec. Aust. Mus. 18(4), p. 226, pl. 25, figs. 11, 14.
 1954 *Eugemmula hawleyi* Iredale, Laserson, The N. S. W. Turridae, Handb. Roy. Zool. Soc. N.S.W., p. 7, pl. 1, figs. 5-7.

Type—Australian Museum, Sydney.

Records—NEW SOUTH WALES: Sow and Pigs Reef, Port Jackson ("Triton" dredgings, type locality); Crowdy Head, dredged; off Port Stephens (Laserson, 1954).

Gemmula rotatilis (Martens, 1902)

(Pl. 198, fig. 3)

Range—Off Somalia, East Africa, 1134 metres.

Remarks—This shell was described from a not fully mature shell as evidenced by the size of the protoconch in relation to the rest of the shell. The protoconch is polygyrate, narrowly conic, and closely and radially ribbed. The general appearance of the shell suggests alliance with the Duntroonian, Upper Oligocene *longwoodensis* Powell, 1942, from Southland, New Zealand. The East African shell, compared with the New Zealand fossil, has larger, peripheral, pointed nodes on the sinus area; and the single subsutural spiral cord is stronger, narrowly crested and more prominently raised. Both species are strongly angulated at the periphery but are not carinate-flanged.

Measurements (mm.)—

height	width	
11.5	5.0	from von Martens

Synonymy—

- 1902 *Pleurotoma (Gemmula) rotatilis* Martens, Sitzungber. der Gesellsch. nat. Freunde, Berlin, p. 239; 1903, Gast. Deutsch. Tiefsee-Exped., 1898-1899, 7, p. 78, pl. 1, fig. 3.

Types—The type locality is off Mogadiscio, Somalia, East Africa, 1° 49' N., 45° 29' E., in 1134 metres.

Gemmula iris (Vredenburg, 1921)

(Pl. 204, figs. 1, 2)

Range—Burma, Tertiary.

Remarks—This species has a very tall and narrow spire but a somewhat truncated anterior canal. The whorls are evenly and lightly convex, the gemmate double sinus rib projecting less than the subsutural fold. Protoconch tall and conical, first 1½ whorls smooth, the remaining 1½ whorls strongly axially costate. Spire height almost twice the height of aperture plus canal.

Measurements (mm.)—

height	width
19.0	6.0

Synonymy—

- 1921 *Pleurotoma (Hemipleurotoma) iris* Vredenburg, Rec. Geol. Surv. India 53(2), p. 98, pl. 12, figs. 14, 15.

Records—BURMA: Kyaungon, Thanga (Tertiary).

Gemmula thyrus (Vredenburg, 1921)

(Pl. 204, fig. 4)

Range—Burma, Tertiary.

Remarks—This narrowly fusiform shell is characterised by a strong, sharply crested subsutural fold, a strong gemmate peripheral carina and a prominent smooth cord between the periphery and the lower suture. Spire about 1.1 times height of aperture plus canal.

Measurements (mm.)—

height	width	
13.3	4.1	estimated from figure

Synonymy—

- 1921 *Pleurotoma (Gemmula) thyrus* Vredenburg, Rec. Geol. Surv. India 53(2), p. 103, pl. 12, figs. 11.

Records—BURMA: Kyaungon, Myauknigon, Thanga (Tertiary).

Gemmula birmanica (Vredenburg, 1921)

(Pl. 204, fig. 3)

Range—Burma, Tertiary.

Remarks—The author of this species remarked that it is probably a premutation of *Pleurotoma carinata woodwardi* Martin, a fossil which occurs abundantly in the Pliocene formations of Java. "The Burmese shell appears to be distinguished principally by its smaller size, its decidedly smaller protoconch, its somewhat better developed circum-sutural rim, and its generally more elongate spire."

It has a relatively short canal as in *iris* but is distinguished from that species in the greater prominence of the peripheral carina, which angulates the whorls. Height of spire about 1.3 times height of aperture plus canal.

Measurements (mm.) —

height	width	
21.0	8.0	estimated from figure

Synonymy —

1921 *Pleurotoma* (*Gemmula*) *birmanica* Vredenburg, Rec. Geol. Surv. India 53(2), p. 102, pl. 12, fig. 12.

Records — BURMA: Dalabe, Kyaungon, Myauknigon, Thanga (Tertiary).

Gemmula pakistanica (Eames, 1952)

(Pl. 204, fig. 8)

Range — Eocene of Pakistan, Zinda Pir section (Upper Chocolate Clays).

Remarks — Compared by its author with *Pleurotoma* (*Gemmula*) *sindiensis* Vredenburg from the Lower Nari of Bhagothoro Hill, Sind, which has a higher spire, *Pleurotoma* (*Hemipleurotoma*) *bonneti bhagothorensis* Vredenburg from the same locality and *Pleurotoma* *tricincta* Martin, 1935, from the Neogene of Buton, which is more broadly conic.

Measurements (mm.) —

height	width	
6.7 +	3.4	holotype

Synonymy —

1952 *Turris* (*Gemmula*) *pakistanica* Eames, Phil. Trans. Roy. Soc. London, Ser. B., No. 631, vol. 236, p. 124, pl. 5, fig. 116.

Gemmula soriensis (Eames, 1952)

(Pl. 204, fig. 5)

Range — Eocene of Pakistan, Zinda Pir section (Ghazij Shales).

Remarks — Compared by its author with *Pleurotoma* (*Gemmula*) *sindiensis* Vredenburg from the Lower Nari of Bhagothoro Hill, Sind, and the foregoing species, *pakistanica* Eames, the former having a higher spire and more numerous anterior spirals and the latter a more broadly conic spire and narrower, more projecting peripheral carina than in *soriensis*.

Measurements (mm.) —

height	width	
7.9	3.0	holotype

Synonymy —

1952 *Turris* (*Gemmula*) *soriensis* Eames, Phil. Trans. Roy. Soc., London, Ser. B, No. 631, vol. 236, p. 126, pl. 5, fig. 114.

Gemmula karangensis (Martin, 1895)

(Pl. 204, figs. 6, 7)

Range — Lower Miocene, Karang, Java.

Remarks — This species has a bicarinate moderately projecting keel, distantly crenulated rather than gemmate. From the small and not very distinct figures the subsidiary spirals appear thin and sharply raised. The surface is crossed by thin axial threads which do not appear to render the subsidiary spirals gemmate. The specimen is probably immature. The author compares the species with *coronifera* Martin and *carinata* Gray.

Synonymy —

1895 *Pleurotoma* (s. str.) *karangensis* Martin, Samml. geol. Reichs-Mus., Leiden, 1, p. 36, pl. 6, figs. 90, 90a.

Gemmula kotorai (Nomura & Zinbo, 1935)

Range — Japan, Yanagawa shell-beds in Hukusima Basin, N.E. Honshu, Miocene.

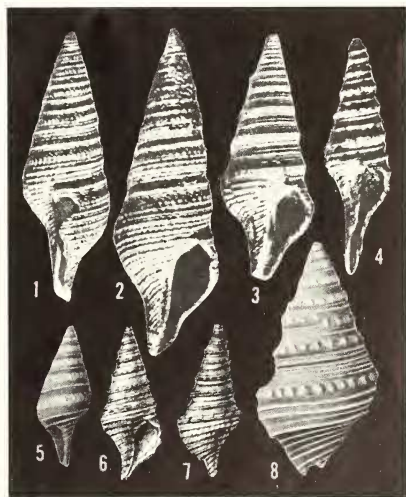


Plate 204. Figs. 1, 2, *Gemmula iris* (Vredenburg). Holotype. Tertiary: Thanga, Kyaungon, Burma (from Vredenburg, 1921, pl. 12, figs. 14, 15). Fig. 3, *Gemmula birmanica* (Vredenburg). Holotype. Tertiary: Thanga and Dalabe, Burma (from Vredenburg, 1921, pl. 12, fig. 12). Fig. 4, *Gemmula thyrus* (Vredenburg). Holotype. Tertiary: Thanga, Burma (from Vredenburg, 1921, pl. 12, fig. 11). Fig. 5, *Gemmula soriensis* (Eames). Holotype. Eocene: Ghazij Shales, Zinda Pir section, Pakistan (from Eames, 1952, pl. 5, fig. 114). Figs. 6, 7, *Gemmula karangensis* Martin. Lower Miocene: Karang, Java (from Martin, 1895, pl. 6, figs. 90, 90a). Fig. 8, *Gemmula pakistanica* (Eames). Holotype. Eocene: Zinda Pir section, Pakistan (from Eames, 1952, pl. 5, fig. 116).

Remarks — It is impossible to tell from the figure what this unique fossil is like. Its authors state that "This species resembles *T. (Gemmula) granosa* (Helbling), a well-known living and fossil species in Japan and the Malayan Archipelago, but the present shell is smaller with fewer revolving cords and less granular sculpture."

Measurements (mm.) —

height	width	
9	4	holotype

Synonymy —

1935 *Turris (Gemmula) kotorai* Nomura & Zinbo, Saito Ho-on Kai Mus., Res. Bull. No. 6, p. 170, pl. 15, fig. 18.

Gemmula kishimaensis Shuto & Ueda, 1963

Range — Japan, Upper Eocene to Middle Oligocene.

Remarks — From the fairly detailed description and figures of this species it would seem to be a true *Gemmula*, not a member of the subgenus *Hemipleurotoma*, as claimed by its authors. Certainly it is described as having a paucispiral protoconch, but this statement is qualified by the remark "but the details are unknown." However, Glibert (1960, p. 6) considered *Hemipleurotoma* to be a synonym of *Gemmula*.

Description — Adult shell 11 to 15 mm. (about ½ inch). Shell narrowly fusiform with tall spire and presumed long canal. Median carina heavy, strongly gemmate. Shoulder steeply descending. Subsutural fold broad but not prominent and bearing weak spiral lirations. Four primary spirals below the periphery to the basal subangulation.

Measurements (mm.) —

height	width
15.1	9.0
11.5	—

Synonymy —

1963 *Gemmula (Hemipleurotoma) kishimaensis* Shuto and Ueda, Japanese Journal of Geology and Geography 34, no. 1, p. 4, pl. 1, figs. 6, 11.

Types — The holotype is in the Kyushu University, Japan.

Records — JAPAN: Obo, Saga Prefecture, Mazean Stage (Middle Oligocene) (type locality).

New Zealand Tertiary *Gemmula*

The genus *Gemmula* is not found living in New Zealand waters but it was well represented during

the warmer periods of the Eocene, Oligocene and Miocene and seems finally to have become extinct here in the lower Pliocene. Following is a list of the New Zealand species.

Gemmula bimarginata (Suter, 1917)

Locality — N.Z.G.S. loc. 630, Teaneraki, Enfield, near Oamaru (probably McCullough's Bridge, South Canterbury; Bortonian, Eocene). The type is in the New Zealand Geological Survey, Wellington.

Synonymy —

1917 *Turris bimarginatus* Suter, N. Z. Geol. Surv. Pal. Bull. 5, p. 44, pl. 5, fig. 13.

1942 *Gemmula bimarginata* Suter, Powell, Bull. 2, Auckland Inst. Mus., p. 49.

Gemmula clifdenensis Powell, 1942

(Pl. 205, fig. 1)

Locality — Clifden (6c.), Southland (Altonian, Miocene). The type is in the Auckland Museum.

Synonymy —

1942 *Gemmula clifdenensis* Powell, Bull. 2, Auckland Inst. Mus., p. 49, pl. 13, fig. 14.

Gemmula disjuncta Laws, 1936

Locality — Kaawa Creek, south of Port Waikato (Opoitian, Lower Pliocene). The type is in the Auckland Museum.

Synonymy —

1928 *Turris* cf. *duplex* Suter, Bartrum & Powell, Trans. N. Z. Inst. 59, p. 151.

1936 *Gemmula disjuncta* Laws, Trans. Roy Soc. N. Z. 66, p. 120, pl. 17, fig. 82.

Gemmula duplex (Suter, 1917)

Locality — McCullough's Bridge, South Canterbury (Bortonian, Eocene). The type is in the New Zealand Geological Survey, Wellington.

Synonymy —

1917 *Turris duplex* Suter, N. Z. Geol. Surv. Pal. Bull. 5, p. 45, pl. 5, fig. 15.

Gemmula kaiparaensis (Marshall, 1918)

Locality — Pakaurangi Point, Kaipara (Altonian, Miocene).

Synonymy —

1918 *Turris kaiparaensis* Marshall, Trans. N. Z. Inst. 50, p. 268, pl. 18, figs. 9, 9a.

Gemmula lawsi Powell, 1942

(Pl. 205, fig. 2)

Locality — Pakaurangi Point, Kaipara (Altonian, Miocene).

Synonymy —

1942 *Gemmula lausi* Powell, Bull. 2, Auck. Inst. Mus., p. 50, pl. 13, fig. 12.

Gemmula longwoodensis Powell, 1942

(Pl. 205, fig. 3)

Locality — N.Z.G.S. loc. 2563, Longwood, S. D., Orepuki, Southland (Duntroonian, Upper Oligocene). The type is in the New Zealand Geological Survey, Wellington.

Synonymy —

1942 *Gemmula longwoodensis* Powell, Bull. 2, Auck. Inst. Mus., p. 49, pl. 13, fig. 13.

Gemmula margaritata (Marshall, 1919)

Locality — Hampden, Otago (Bortonian, Eocene).

Synonymy —

1919 *Turris margaritatus* Marshall, Trans. N. Z. Inst. 51, p. 230, pl. 17, fig. 2.

Gemmula orba Marwick, 1931

(Pl. 206)

Locality — N.Z.G.S., loc. 1322, Ormond Series, Gisborne (Upper Miocene). The type is in the New Zealand Geological Survey, Wellington.

Synonymy —

1931 *Gemmula orba* Marwick, N. Z. Geol. Surv. Pal. Bull. 13, p. 133, pl. 15, fig. 277.

Gemmula ornata (Marshall, 1918)

Locality — Pakaurangi Point, Kaipara (Altonian, Miocene).

Synonymy —

1918 *Turris ornatus* Marshall, Trans. N. Z. Inst. 50, p. 268, pl. 18, figs. 8, 8a.

Gemmula peraspera Marwick, 1931

(Pl. 206)

Locality — N.Z.G.S., loc. 1322, Ormond Series, Gisborne (Upper Miocene). The type is in the New Zealand Geological Survey, Wellington.

Synonymy —

1931 *Gemmula peraspera* Marwick, N. Z. Geol. Surv. Pal. Bull. 13, p. 133, pl. 15, fig. 276.

Gemmula polita (Marshall, 1919)

Locality — Hampden, Otago (Bortonian, Miocene).

Synonymy —

1919 *Turris politus* Marshall, 1919, Trans. N. Z. Inst. 51, p. 230, pl. 17, fig. 9.



Plate 205. Tertiary New Zealand *Gemmula*. Fig. 1, *G. cliffdenensis* Powell, Altonian, Miocene: Chifden, Southland. Fig. 2, *G. lausi* Powell, Altonian, Miocene: Pakaurangi Point, Kaipara. Fig. 3, *G. longwoodensis* Powell, Duntroonian, Upper Oligocene: Orepuki, Southland (all from Powell, 1942, pl. 13, figs. 14, 12 and 13 respectively).

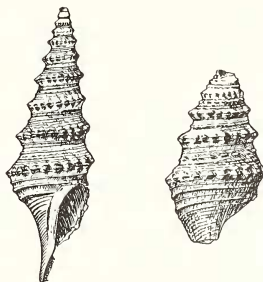


Plate 206. *Gemmula peraspera* Marwick (left fig.) and *G. orba* Marwick (right fig.). Upper Miocene: Gisborne, Ormond Series, New Zealand (from Marwick, 1931, pl. 15, figs. 276, 277).

***Gemmula reticulata* (Marshall, 1919)**

Locality — Hampden, Otago (Bortonian, Eocene).

Synonymy —

1919 *Turris reticulatus* Marshall, Trans. N. Z. Inst. 51, p. 231, pl. 17, fig. 8.

***Gemmula waihaoensis* Finlay, 1924**

Locality — McCullough's Bridge, South Canterbury (Bortonian, Eocene).

Synonymy —

1917 *Turris regius* Suter, N. Z. Geol. Surv. Pal. Bull. 5, p. 46, pl. 12, fig. 14 (non Röding, 1798).

1924 *Gemmula waihaoensis* Finlay, Proc. Malac. Soc. 16, p. 103.

Australian Tertiary *Gemmula****Gemmula gellibrandensis* Chapple, 1934**

Remarks — This species is atypical, if Chapple's original description is as stated: "Protoconch of two convex whorls; initial portion slightly inflated, oblique; anterior whorl costate." The type is in the National Museum in Melbourne, Australia.

Locality — Princetown, $\frac{1}{2}$ mi. W. of Gellibrand River, Victoria (Balcumbian, Miocene).

Synonymy —

1934 *Gemmula gellibrandensis* Chapple, Mem. Nat. Mus. Melb. 8, p. 163, pl. 19, figs. 3, 3a.

***Gemmula samueli* (Tenison-Woods, 1879)**

Remarks — This species is not a typical *Gemmula*; the protoconch, although multispiral, develops axials only over the last 2 whorls, the initial $2\frac{1}{2}$ being smooth and polished. The double peripheral carina is axially costate rather than gemmate and the broad U-shaped peripheral sinus is not so deep as in most species of *Gemmula*. The subsidiary spirals, however, especially those on the base, are truly gemmate where crossed by the relatively weak axials.

In its slender fusiform shape, its tubercular rather than gemmate peripheral sculpture and its open U-shaped sinus, the species approaches *Lucerapex*. Members of the latter genus, however, have a smooth paucispiral protoconch.

The species *samucli* could represent a trend in *Gemmula* from which the prototype of *Lucerapex* could have been derived, or perhaps more likely, *Lucerapex* could be considered as a derivation from *Fusiturris*.

The Victorian *Pleurotoma murrayana* Pritchard, 1904, from the same horizon as *samucli*, appears to

be a true *Lucerapex*. It is described as having a protoconch of $2\frac{1}{2}$ whorls, with a blunt apex, smooth and inclined to be angled medially. The whorls are nodosely keeled and there is a broad deep sinus on the shoulder.

Measurements (mm.) —

height	width	
15.5	4.7	Altona Shaft

Locality — Muddy Creek, lower beds, Victoria (Balcumbian, Miocene) (type locality); Altona Shaft.

Synonymy —

1879 *Pleurotoma samueli* Tenison-Woods, Proc. Linn. Soc. N. S. W. 3, p. 226, pl. 20, fig. 3.

1944 *Gemmula samueli* Tenison-Woods, Powell, Rec. Auck. Inst. Mus. 3(1), p. 13.

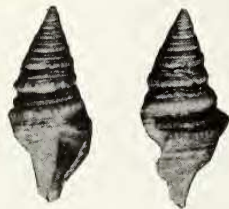


Plate 207. *Gemmula husamaru* Nomura. Off Tiba Prefecture, Japan. An indeterminate species (from Nomura, 1940, pl. 1, figs. 4a, b).

Subgenus *Unedogemmula* MacNeil, 1960

Type: *Turris unedo* Kiener, 1839-40

Originally proposed as a genus, *Unedogemmula* is here reduced to subgeneric status. It is *Lophiotoma*-like in its adult stage, having a plain peripheral keel but the early whorls show distinct gemmulations on the keel. Occasional examples have the gemmules persisting over most of the keel. It could be a *Gemmula* tending towards obsolescence of the gemmules or a *Lophiotoma* exhibiting vestigial evidence of the origin of that group from *Gemmula*. At most, *Unedogemmula* would appear to merit no more than subgeneric status.

Synonymy —

1960 *Unedogemmula* MacNeil, U. S. Geol. Survey Prof. Paper 339, p. 101 (type by original designation: *Turris unedo* Kiener).

Gemmula unedo (Kiener, 1839-40)

(Pl. 175, figs. 1, 6; pl. 208, figs. 1, 2)

Range — Japan, to the East Indies and the Persian Gulf.

Remarks — This large attractive *Gemmula* is more common in Japan than elsewhere in its rather wide range. It is characterized by its light yellowish colour over which are numerous, small flecks of darker brown, by sharply indented suture, by its deep, rather large, U-shaped sinus, by the concave upper shoulder, and by the numerous, rough spiral threads on the lower three-fourths of the last whorl. The peripheral carina is weakly gemmate in the first few post-nuclear whorls, although in some specimens the beading may persist to the penultimate whorl. *G. deshayesii*, also from south-east Asia, differs in being an almost solid tan with a few axial, zigzag flames of cream, in being smoother, and in having a proportionately smaller and shallower sinus.

A large series of specimens from the Persian Gulf from the Townsend collection in the British Museum confirm the suspicion that Melvill's *Turris invicta* are young *unedo*.

Description — Adult shell, 75-105 mm. (3-4 inches) in height, solid, fusiform, with a tall spire and long anterior canal. Spire a little more than the height of the aperture plus canal; spire angle 30-35. Sculptured firstly with two narrow, sharply raised, spiral cords submarginating the suture, followed by a bimarginate sinus rib which forms the

peripheral angle, at a little below median whorl height, then 2-3 primary spiral cords emergent between the sinus rib and the lower suture. On the base and neck there are about seventeen primary spirals. On the concave shoulder area there are from 4 to 7 crisp secondary spirals. All the interspaces carry from one to three spiral threads. Whorls 12-13, exclusive of a multispiral narrowly conic, smooth protoconch of 3-3½ whorls, terminating in a half whorl of brephic axials. The early post-nuclear whorls bear distinct gemmules on the peripheral carina and in a few instances these persist over most of the remaining whorls. Colour pattern consisting of small reddish-brown dots, diffused into slightly larger maculations around the subsutural collar and the sinus rib, the whole loosely and irregularly connected axially by flexuous pale reddish-brown streaks that follow the successive growth lines. Ground colour and interior of aperture white. In occasional specimens from Japan, the sinus rib carries a third but weaker spiral than the two marginating ones. This feature is clearly shown in Kiener's illustration of the species. Operculum leaf-shaped, with an apical nucleus.

Measurements (mm.) —

height	width	
105.7	31.0	Tayabas, 190 fathoms, Philippines
94.0	26.5	Tosa, 50 fathoms, Japan
93.5	26.3	Tosa, 50 fathoms, Japan
88.5	27.0	Persian Gulf

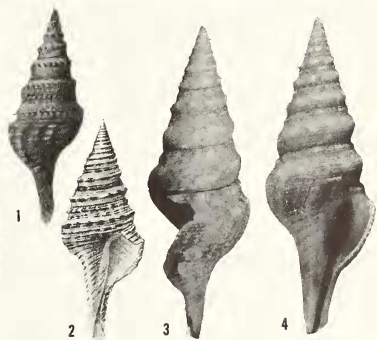


Plate 208. Fig. 1, *Gemmula (Unedogemmula) unedo* (Kiener). "Mers de l'Inde" (from Reeve, 1843, pl. 2, fig. 12). Fig. 2, holotype of *invicta* Melvill, a synonym of *unedo* (from Melvill, 1910, pl. 2, fig. 27). Figs. 3, 4, *G. (U.) binda* (Garrard). Holotype. 75 fms., off Broken Bay, New South Wales, Australia. 77 mm. (photo by D. McMichael).

87.0	28.0	Sagami Bay, Japan
81.4	24.5	Tosa, 50 fathoms, Japan
72.0	24.0	Kii, 40 fathoms, Japan
31.7	12.0	holotype of <i>invicta</i> Melvill

Synonymy —

- 1839-40 *Pleurotoma unedo* Kiener, Coquilles Vivantes, Pleurotome 5, p. 19, pl. 14, fig. 1.
 1843 *Pleurotoma unedo* Kiener, Reeve, Conch. Iconica 1, pl. 2, fig. 12.
 1884 *Pleurotoma unedo* Kiener, Tryon, Manual of Conch. 6, p. 165, pl. 3, fig. 20.
 1910 *Turris invicta* Melvill, Ann. Mag. Nat. Hist., Ser. 8, 6, p. 15, pl. 2, fig. 27.
 1951 *Turris unedo* Kiener, Hirase & Taki, Handb., Illustr. Shells Japan, pl. 115, fig. 2.
 1954 *Gemmula unedo* Kiener, Kira, Coloured Illustr. Shells Japan, pl. 35, fig. 17.
 1956 *Gemmula unedo* Kiener, Kaicher, Indo-Pacific Sea Shells, pl. 1, fig. 11.
 1960 *Unedogemmula unedo* Kiener, MacNeil, U. S. Geol. Surv. Prof. Paper 339, p. 101.

Types — Kiener's type locality is "mers de l'Inde." Melvill's type of *invicta* is in the British Museum (Natural History).

Records — JAPAN: Tosa, 40-50 fathoms; Sagami Bay; Awa, Nushima, Awaji; Wakayama; Nagasaki (ANSP); Kii, 40 fathoms (A.W.B.P. coll.). PHILIPPINES: Tayabas Bay, Luzon, green mud, 190 fathoms; off Laus Point, E. Cebu, grey mud and sand, 159 fathoms; S. of Tayabas Lt., Luzon, black sand, 106 fathoms; off Point Talin, Luzon, mud, shell and coarse sand, 114 fathoms; off Pt. Dumureg, Mashate, green mud, 153 fathoms; W. of Balabac Island, 148 fathoms; off Davao, Mindanao, 135 fathoms; S.W. of Corregidor Lt., Luzon, mud, shell and coarse sand, 118 fathoms (Albarreros, USNM). CHINA SEA: S. of Pratas Island, 153 fathoms (USNM). MOLUCCAS: Molucca Pass, off Makyan Island, grey mud, 275 fathoms (USNM). PERSIAN GULF (Townsend collection; type locality of *invicta*): Gulf of Oman, 73 metres (John Murray Exped., Sta. 72).

Gemmula binda (Garrard, 1961)

(Pl. 208, figs. 3, 4)

Range — New South Wales, 75 fathoms.

Remarks — This species is based upon a single specimen which may yet prove to be identical with the wide-ranging *unedo*. The New South Wales shell appears to differ from *unedo* only in having a more obtusely rounded periphery with a weaker sinus rib and a shallower shoulder concavity. Also the basal spirals are more numerous and therefore more closely spaced. Examination of the type specimen shows the sinus to be moderately deep, V-shaped, on the peripheral carina. At least six of the early post-nuclear whorls are gemmate.

Description (original) — "Shell large, heavily built, with tall slender spire, eleven main whorls, apical whorls missing; outer lip, although damaged, appears to have been sharp, without any folding or thickening, and sinus on peripheral keel; fourteen well developed raised revolving threads visible within the aperture; anterior canal fairly long and

straight, small portion missing; whorls sharply angled at periphery, with a broad concave shoulder and well rounded base; sculpture consists of numerous well defined revolving lirae; interspersed with finer threads, crossed by oblique growth lines veering to right above periphery and to left below it, where sculpture has a general granulated appearance; one well defined thread prominent just below suture, two other fairly smooth prominent threads form the peripheral keel, whilst sculpture generally tends to become smoother towards anterior end of shell; colour consists of chestnut spots on prominent thread below suture and on periphery, with more general blotching on lower part of main whorl; background and interior of aperture white."

Measurements (mm.) —

height	width	
77.0	25.0	holotype

Synonymy —

- 1961 *Turris binda* Garrard, Journ. Malac. Soc. Aust., No. 5, p. 32, pl. 1, fig. 7.

Records — NEW SOUTH WALES: off Broken Bay, 75 fathoms (type locality). The holotype is in the Australian Museum, Sydney.

Gemmula deshayesii (Dumet, 1839)

(Pl. 175, figs. 7, 8; pl. 210, figs. 1, 2)

Range — Japan, China and Hongkong.

Remarks — This moderately common, east Asian species is characterized by an unusually solid shell, by its almost uniform, tawny to olive-brown colour which, however, has flexuous, axial whitish streaks. It differs from *unedo* (Kiener) in having a proportionately shorter anterior canal, in having smoother spiral cords, and in lacking numerous, small brown flecks.

Both Kiener (1839-40) and Reeve (1843) erroneously identified this species as *indica* Deshayes, 1832. The latter species is larger, broader, less solid, with strong flecks and spots of brown, and known only from a single Ceylonese specimen. Tryon (1884) erroneously considered *deshayesii* to be a synonym of *indica* Deshayes because of Kiener's and Reeve's earlier errors. Some Japanese authors have erroneously applied the name of *polytropa* (Helbling) to this species, evidently on von Marten's assumption in 1869 (Malakozool. Blätter 16, p. 235).

Description — Adult shell 65-70 mm. (2½-2¾ inches) in height, solid, fusiform with a tall spire and long anterior canal. Spire a little more than the height of the aperture plus canal; spire angle

27°-30°. Sculpture rather uniformly and closely lirate except for one smooth primary cord below the suture and a not very prominent bicarinate sinus rib, situated just below the middle of whorl height. Below this and over the base there is a closely packed, rather indefinite assortment of primary and secondary cords and interstitial threads. There are 5 or 6 crisp threads on the shoulder area; and 4 to 6 of the post-nuclear whorls are distinctly gemmate. Whorls of rather straight outline, shoulder weakly concave and sinus rib not prominently projecting. Number of whorls 10-11, exclusive of a polygyrate, narrowly conic, smooth protoconch of approximately four whorls, the last axially costate. None of the available protoconchs are sufficiently well preserved for more accurate description. Colour uniformly olive or yellowish olive with a few white, flexuous, axial streaks which follow the trend of the growth lines and appear to coincide with rest stages of growth. Interior of aperture, columella and anterior canal white.

Measurements (mm.).—

height	width	
64.0	18.5	Hongkong
61.0	18.0	Hongkong
60.0	18.25	Hongkong
54.0	15.5	Kii, Japan

Synonymy —

- 1839 *Pleurotoma deshayesi* Doumet, Rev. Zool. (Soc. Cuv.) 2, p. 325 (description only).
 1840 *Pleurotoma deshayesi* Doumet, Guérin's Mag. Zool., Anat. Comp. & Zool., pl. 11 (title page dated 1844, plate 1840). "Mers de la Chine."
 1843 *Pleurotoma deshayesi* Doumet, Reeve, Conch. Iconica 1, pl. 3, fig. 19 (China).
 1876 *Pleurotoma deshayesi* Doumet, Weinkauff, Conch. Cab. 4(3), p. 26, sp. 22, pl. 5, fig. 7.
 1884 *Pleurotoma indica* Deshayes (in part), Tryon, Manual of Conch., 6, p. 168, pl. 6, fig. 80 only.
 1886 *Pleurotoma deshayesi* Doumet, Watson, Challenger Zool. 15, p. 284.
 1960 *Turris polytropia* Helbling, Kira, Coloured Illustr. Shells Japan, pl. 35, fig. 16.

Records — JAPAN: Fukura, Awaji (USNM); Minoshima, Wakayama-ken; Kii (ANSP and A. W. B. Powell coll.). CHINA: Foochow; Amoy; Pei-tai-lo, N. Chihli coast (USNM). TAIWAN: (ANSP). HONG KONG: (USNM; A. W. B. Powell coll.); 20-30 fms., Hong Kong (ANSP); Aap Li Chau, Hong Kong (R. D. Purchon, ANSP).

Gemmula indica (Deshayes, 1832)

(Pl. 209)

Range — Known only from Ceylon.

Remarks — This large attractive species is evidently known from only one specimen which was collected by Ch. Belanger in Ceylon. I have not had an opportunity to examine the type, and have provisionally placed it in the subgenus *Uncdogemmula*. It resembles *unedo* (Kiener), but ap-

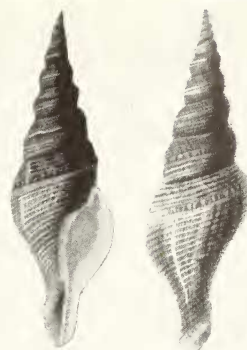


Plate 209. "*Pleurotoma*" *indica* Deshayes. Ceylon (from Belanger, 1832, pl. 2, figs. 9, 10).

pears to differ in having a proportionately broader body whorl, a shorter anterior canal, more rounded whorls in the spire and in having a much darker brown coloration. *G. indica* (Deshayes) is umbilicate, but this feature may be due to an abnormality which is known to occur in other species. Should this species be re-discovered and prove to be a true *Turris* or a *Lophiotoma* it will have to be re-named because of *Lophiotoma indica* (Röding, 1798).

Description — Shell 80 mm. (about 3 inches) in length, fusiform, moderately solid, with a high spire, a broad body whorl, and a rather short an-

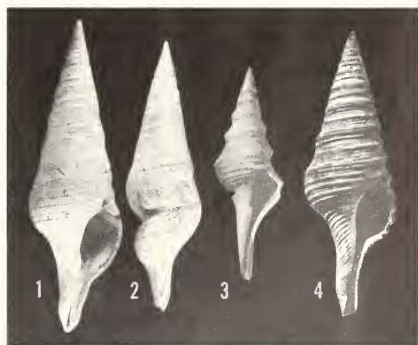


Plate 210. Figs. 1, 2, *Gemmula* (*Uncdogemmula*) *deshayesi* (Doumet). Awaji, Japan. 60 mm. Fig. 3, *G. (U.) indica* MacNeil, Miocene of Okinawa Id., Ryukyu Ids. 40.2 mm. (from MacNeil, 1960, pl. 5, fig. 7). Fig. 4, *G. (U.) koolhovei* Oostingh, Pliocene of South Bantam, Java Id., Indonesia (from Oostingh, 1938, pl. 1, fig. 22).

terior canal which is umbilicate. Sinus deep and U-shaped. Whorls in spire convex and only slightly angulate. Sinus scar appears to be flattish and axially striate. Color of shell yellowish brown with darker brown axial, narrow streaks on the body whorl, and with dark-brown spots and spiral streaks on the sinus scar and on the numerous spiral subsutural threads.

Measurements (mm.)—

height	width	
80	26	from the type figure

Synonymy—

1832 *Pleurotoma indica* Deshayes, in Belanger's Voyage aux Indes-Orientales, Pt. 2, Zoologie, p. 421, Mollusques pl. 2, figs. 9, 10 (December).

Types—The type locality is the "côtes de Ceylan." I do not know the present location of the type.

Records—Known only from Ceylon (Deshayes, 1832).

Gemmula hastula (Reeve, 1843)

(Pl. 211)

Range—Persian Gulf and Arabian Sea.

Remarks—This species is based upon a single well-preserved specimen of unknown locality in

the British Museum. However, a series of specimens in the John Murray Expedition material is from the Persian Gulf, and a further locality is added by an undoubted synonym, *Pleurotoma trypanodes* Melvill, 1904, from the Arabian Sea.

This species is certainly not a synonym of *indica* Röding, 1798 (= *marmorata* Lamarck, 1822) as claimed by Tryon (1884). From *indica* it is distinguished by more prominent subsutural and less prominent peripheral spirals, resulting in a regularly conic not pagodiform spire. Further, the protoconch of four whorls, two smooth and two axially costate, followed by weak gemmules on the peripheral carina of the first post-nuclear whorl, make the reference of the species to the subgenus *Unedogemmula* positive.

Melvill's *Pleurotoma trypanodes* is based upon a bleached and somewhat worn example of *hastula*. Melvill's illustration gives the impression of rather profuse granulation of the spiral cords, but except for weak granules on the carina of the first 2 or 3 post-nuclear whorls, subsequently it is not the cords that are granulate but a false impression of granulation resulting from dense axial threads between the cords and these are strongest above the peripheral carina.

Description—Shell rather small and slender, 21–32 mm. (about 1 inch) in height, with a tall, narrowly conic spire and a long, almost straight anterior canal. Spire very slightly less than the height of the aperture plus canal. Adult sculpture of regular, smooth, spiral cords, the most prominent being a closely spaced, subsutural pair and a single peripheral one which terminates in a deep, narrow sinus. Three closely spaced spiral threads present between the subsutural and the peripheral carinae, and two pairs of threads, alternately strong and weak, are between the peripheral carina and the lower suture. Base rather densely sculptured with relatively strong and weaker intermediate spirals. Colour whitish, obscurely axially marked and diffused with yellowish-brown.

Measurements (mm.)—

height	width	
21.0	7.0	holotype of <i>trypanodes</i> Melvill
28.0	8.0	Persian Gulf, 73 metres
29.0	9.0	Arabian Sea, 40 fathoms
32.5	9.0	holotype of <i>hastula</i> Reeve

Synonymy—

1843 *Pleurotoma hastula* Reeve, Conch. Iconica 1, pl. 17, fig. 139 (locality unknown).

1904 *Pleurotoma trypanodes* Melvill, Proc. Malac. Soc. 6, p. 57, pl. 5, fig. 2.

1917 *Turris (Tomopleura) trypanodes* Melvill, Proc. Malac. Soc. 12, p. 148.



Plate 211. *Gemmula (Unedogemmula) hastula* (Reeve, 1843). Holotype from the British Museum (Natural History). Locality unknown, but probably the Persian Gulf. 38.5 mm.

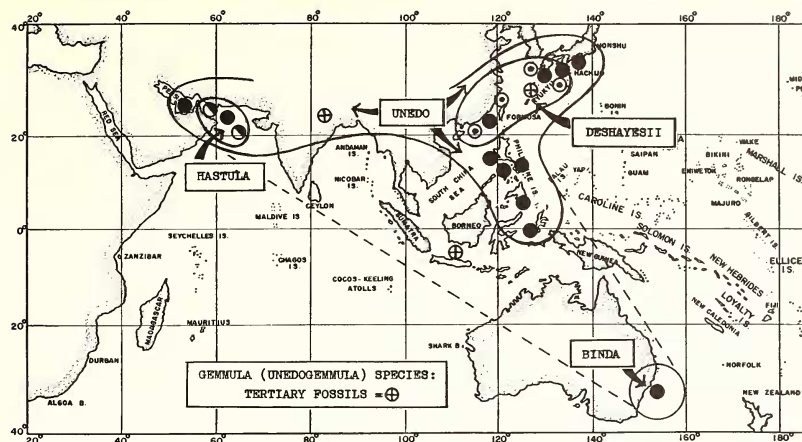


Plate 212. Geographical distribution of *Gemmula* (*Unedogemmula*) *unedo* (Kiener), *deshayesii* (Dumet), *hastula* (Reeve), and *binda* (Garrard).

Types—The types of both *hastula* Reeve and *trypanodes* Melvill are in the British Museum (Natural History).

Records—ARABIAN SEA: 18° 58' N; 71° 45' E., 40 fathoms (type locality of *trypanodes*); 100 miles W. of Bombay, on cable (Brit. Mus.). PERSIAN GULF: 25° 38' 18" N.; 56° 26' 36" E., 73 metres (John Murray Exped. Sta. 72; Brit. Mus.).

Gemmula bemmeleni (Oostingh, 1941)

Remarks—The author of this species remarks that it is very close to his *koolhoveni* but it has more numerous spirals. He compares it with “*polytropia* Helbling” (i.e., *Lophioturris leucotropis* Adams & Reeve, 1850), but *bemmeleni* by its gemmate early whorls is clearly a *Unedogemmula*.

Measurements (mm.)—

height	width	spire angle
30	18	35

Synonymy—

1941 *Turris* (*Gemmula*) *bemmeleni* Oostingh, De Ingenieur in Ned-Indie, No. 7, p. 64, fig. 2.

Records—Central JAVA, Semarang (Pliocene).

Gemmula ina MacNeil, 1960

(Pl. 210, fig. 3)

Range—Okinawa (Miocene).

Remarks—This fossil species differs from both *unedo* and *deshayesii* in having the peripheral

angle more prominent and situated at about the lower third of whorl height, which gives a pagodiform profile to the spire. Also the shoulder is straight, not deeply concave as in these other Recent species. MacNeil compared his species with *indica* Röding, but that species has a paucispiral protoconch, lacks gemmules on the early whorls and is therefore more satisfactorily located in *Lophioturris*.

Description (original) — “Shell of medium size, fusiform. Protoconch not preserved on type. Aperture about half as long as shell, produced anteriorly to form a straight canal. Anal sinus as determined by growth lines openly V-shaped, slightly broader at the inner end than the peripheral keel. Parietal callus thin. Whorls angulate with a prominent peripheral keel. Sculpture consisting of moderately strong revolving lines on the lower part of the body-whorl with secondary and tertiary threads and less prominent revolving lines on the subsutural slope and columella. Subsutural collar persistent in adult stage, very strong in young gemmulate stage.”

Measurements (mm.)—

height	width	holotype
40.2	13.0	

Synonymy—

1960 *Unedogemmula ina* MacNeil, U. S. Geol. Surv. Prof. Paper 339, p. 102, pl. 5, fig. 7.

Type locality—Okinawa (Yonabaru clay, Miocene).

***Gemmula koolhoveni* (Oostingh, 1938)**

(Pl. 210, fig. 4)

Remarks—This species, described as a *Turris* (*Gemmula*), has gemmules only on the upper spire whorls and in this and in its general likeness to *unedo* Kiener suggests location in the subgenus *Unedogemmula*. From *unedo*, the Javanese Pliocene species differs mainly in its stronger spiral sculpture.

Measurements (mm.)—

height	width	
39	12	holotype
50.5	—	(Oostingh)

Synonymy—

1938 *Turris* (*Gemmula*) *koolhoveni* Oostingh, Die Moll. Plioc. Sud. Bantam in Java, De Ingen. Ned-Indie, Gast. I, p. 28, pl. 1, fig. 22.

Records—JAVA: South Bantam (Pliocene).

***Gemmula sondeiana* (Martin, 1895)**

(Pl. 213, figs. 4-6)

Range—Sonde, Java Island, Indonesia, Pliocene.

Remarks—This is by far the most slender-spined member in the subgenus *Unedogemmula*. The spire is very tall and narrow, but the anterior canal relatively short, and the sculpture is of closely-spaced, smooth spirals, except for the not very prominent peripheral carina which is gemmate over the early whorls. Martin did not give any size for this species.

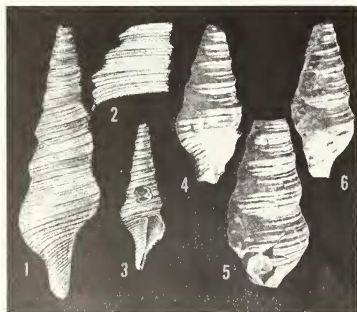


Plate 213. Figs. 1-3, *Gemmula* (*Unedogemmula*) *haydeni* (Vredenburg). Post-Eocene, Mekran beds, India (from Vredenburg, 1925, pl. 9, figs. 4, 5). Figs. 4-6, *G. (U.) sondeiana* (Martin). Pliocene of Sonde, Java Id., Indonesia (from K. Martin, 1895, pl. 6, figs. 89, a, b).

Synonymy—

1895 *Pleurotoma sondeiana* Martin, Die Fossilien von Java. Geol. Reichs-Mus., Leiden, 1, p. 35, pl. 6, figs. 89a, b.

Records—JAVA: Sonde (Pliocene). SUMATRA: Pliocene (K. Martin, 1928, p. 12).

***Gemmula haydeni* (Vredenburg, 1925)**

(Pl. 213, figs. 1-3)

Range—India, post-Eocene.

Remarks—The material upon which this species is based is not very well preserved, for all the figured specimens are without the protoconch and most of the anterior canal. Vredenburg compared his species both with the Javanese Pliocene *sondeiana* Martin, 1895, and with the living species *deshayesii* Doumet, 1839. Vredenburg's remark that "the sinus band is more distinctly crenulated at early stages of growth in *Pleurotoma sondeiana* than in *Pleurotoma haydeni*" suggests that both are in *Unedogemmula*.

The species *haydeni*, judging from the illustrations and very full description, differs from the Recent *deshayesii* mainly in the increased strength of the secondary spiral sculpture which renders the sinus rib less conspicuous.

Measurements (mm.)—

height	width
59 +	21

Synonymy—

1925 *Pleurotoma haydeni* Vredenburg, Mem. Geol. Surv. India 50(1), p. 44, pl. 9, figs. 3-5.

Records—INDIA: west of Garh Hill (Mekran beds, post-Eocene).

***Gemmula ickei* (Martin, 1906)**

(Pl. 214)

Range—Lower Miocene of Java.

Description (from Vredenburg, 1925, p. 40)—Shell rather large, slender, with elongate conical spire, measuring nearly three-fifths of the total height, and with a rather large body whorl, posteriorly globose, anteriorly rather abruptly contracted into a narrow, rather elongate stem, either straight or else steeply tortuous toward its extremity. The protoconch, slightly oblique to the axis of the spire proper, is conoidal and consists of a minute nucleus followed by four convex whorls, the first two of which are smooth, while the two next whorls are decorated with numerous, somewhat oblique ribs stretching from suture to suture.

Synonymy —

1906 *Pleurotoma ickei* Martin, Samml. Geol. Reichs-Mus., Leiden, n.s., 1, p. 293, pl. 43, fig. 703.

1925 *Pleurotoma ickei* Martin, Vredenburg, Mem. Geol. Surv. India 50(1), p. 40.

Records — JAVA: Tjadasngampar, Rembang beds, Lower Miocene, type locality.

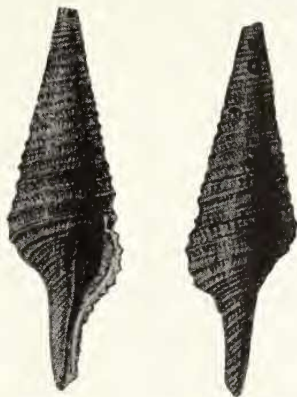


Plate 214. *Gemmula (Unedogemmula) ickei* (Martin). Lower Miocene of Java Id., Indonesia (from K. Martin, 1906, pl. 43, fig. 703).

*Gemmula ickei subspecies
virginoides* (Vredenburg, 1925)

Range — India, post-Eocene.

Remarks — This subspecific name was introduced in a curious way as follows: "Should it therefore be considered necessary to distinguish the Indian specimens, they might be taken to represent a variety *virginoides*." The comparison was with the typical species from the Miocene of Java.

Vredenburg's figures are very indistinct but his remarks, quoted below, indicate an *Unedogemmula*: "Compared with the specimens of *ickei* Martin from the Miocene beds of Tjadasngampar on the Tji Longan in Java the beautiful shell above described agrees in every essential character, with the exception of the crenulations of the sinus ridge which disappear at an earlier stage in the Indian specimens."

The Indian shell is very slender and the spire whorls are strongly sculptured with three spiral ridges. The protoconch is described as conoidal with a minute nucleus, followed by four convex whorls, the first two smooth and the rest axially costate.

Measurements (mm.) —

height	width
46 +	15

Synonymy —

1925 *Pleurotoma ickei virginoides* Vredenburg, Mem. Geol. Surv. India 50(1), p. 44, pl. 1, figs. 8, 9.

Records — INDIA: Gaj of Kach, Teyra River near Rampur (post-Eocene).

[These occasional blank areas occur between genera and subgenera to permit the insertion of new material and future sections in their proper systematic sequence.]

Genus *Pinguiggemula* MacNeil, 1960

Type: *Pinguiggemula okinavensis* MacNeil, 1960

This genus resembles *Gemmula* but has a broadly conic spire, a strongly contracted base and a moderately long, straight anterior canal. In general, all of the spirals at and above the periphery are strong and beaded, while those below the periphery are smooth and much weaker. The protoconch unfortunately is not known, but from fragments remaining is judged to be multispiral. It is something more than a bizarre-shaped *Gemmula*, for the sinus is of very different form from the deep narrow peripheral V-shape of that genus. In *Pinguiggemula* the sinus is very shallowly, broadly open, descending straight at about 30° to the axis, over the shoulder area, then sweeping forward tangentially from the peripheral carina, almost at right angles to the upper arm. All of the Miocene-Pliocene specimens of the type species and most of the Recent shells examined exhibit a curious abnormality of growth in the form of twisted flutings of the outer lip, comparable with those observed in some specimens of *Gemmula congener diomedea* (new subspecies) and in two species of *Ptychosyrinx*.

Speculating on the possible reason for this abnormality, MacNeil (1960) suggested that it may represent a response to an oxygen-poor environment in which one or more incurent siphons are developed. Whatever the cause, it seems to be a gerontic condition which suddenly develops after

full size has been achieved. MacNeil's explanation, however, seems unlikely, since most of the flutings are not hollow.

Synonymy —

1960 *Pinguiggemula* MacNeil, U. S. Geol. Survey Prof. Paper 339, p. 103. Type by original designation: *P. okinavensis* MacNeil, 1960.

Pinguiggemula okinavensis MacNeil, 1960

(Pl. 215, figs. 1, 2)

Range — Okinawa (Miocene or Pliocene).

Description — Adult shell 41.5 mm. (about 1½ inches) in height, stout, with a broadly conic spire, less than height of aperture plus anterior canal, which is moderately long and straight. Protoconch unknown. Subsutural slope bearing 4 strong beaded spirals with deeply channeled interspaces, the lowest one bearing 2 rows of beads and forming the peripheral carina. Sculpture below the periphery consisting of rounded unbeaded spirals which are coarsest below the periphery and become less coarse on the base of the whorl and columella, those on the columella commonly interspaced with secondary spirals. Suture closed and hidden in a deep groove. Anal sinus terminating on the peripheral carina, asymmetrically V-shaped with the lower limb nearly horizontal and the upper limb inclined nearly 45 degrees. (From MacNeil's original description.)

Measurements (mm.) —

height	width	spire angle
41.5	20.2	45° to 60°

Synonymy —

1960 *Pinguiggemula okinavensis* MacNeil, U. S. Geol. Surv. Prof. Paper 339, p. 104, pl. 9, figs. 12-14.



Plate 215

- Figs. 1, 2 *Pinguiggemula okinavensis* MacNeil. Holotype, fig. 2. Miocene-Pliocene, Okinawa Id., Ryukyu Ids., 41.5 mm.
3, 4 *Pinguiggemula luzonica* new species. Holotype, 178 fms., off Menor Id., Luzon Id., Philippines. 35.0 mm.

- 5, 6 *Pinguiggemula philippincensis* new species. Holotype, 250 fms., off Santiago, Luzon Id., Philippines. 50.2 mm.
7 *Pinguiggemula thielei* (Finlay). Holotype of *Pleurotoma (Gemmula) fusiformis* Thiele, 1925, non Sowerby, 1823. 614 meters off west coast of Sumatra Id., Indonesia.

Types – The type locality is Okinawa (Shinzato tuff, Miocene or Pliocene).

Pinguicemmula luzonica new species

(Pl. 215, figs. 3, 4)

Range – Philippine Islands, 178 to 297 fathoms.

Remarks – This species closely resembles the Miocene-Pliocene type of the genus, from which it is distinguished chiefly by its smaller angle of spire, by its slightly longer anterior canal, and in having only two gemmate cords on the spire whorls above the peripheral carina.

Description – Adult shell 35 mm. (about 1½ inches) in height, broadly fusiform, with a squat spire and deeply contracted base, produced into a moderately long tapered and perfectly straight anterior canal. Spire three-fourths of the height of the aperture plus canal. Whorls 9, exclusive of the protoconch of which only the eroded last whorl remains in the holotype. Spire broadly conical, outlines at first slightly concave then lightly convex over the last 4 whorls. Sculpture of spire whorls consisting of 3 very heavy, revolving, flat-topped keels with deeply channelled, narrow, almost linear, interspaces, one subsutural, one peripheral and one intermediate. The subsutural keel bears 3 weak spiral threads; the intermediate keel bears 2 threads; and the third or sinus keel bears 3 threads. All three keels are regularly and very closely gemmate, those of the sinus rib in the form of 3 gemmules fused vertically. Base, including the anterior canal, with 18 smooth primary cords and an intermediate thread in each interspace over the anterior half of the canal. Sinus as described for the genus, with its upper limb descending almost straight, then projecting tangentially forward, but in the case of the holotype, which exhibits the gerontic state mentioned above, the lower edge of the sinus is bent sharply downward along with a fluted and thickened extension of the second basal spiral. Colour uniformly very pale-buff.

Measurements (mm.) –

height	width	spire angle	
35.0	14.0	45°	holotype

Types – The holotype is in United States National Museum, Washington, no. 237784.

Records – PHILIPPINES: off Hermana, Menor Id., Luzon Id., 178 fms., sand, shell and mud (Albatross Sta. 5331) (type locality); off Hermana, Menor Id., 297 fms., green mud (Albatross Sta. 5438, USNM).

Pinguicemmula philippinensis new species

(Pl. 215, figs. 5, 6)

Range – Off Santiago, west Luzon Id., Philippines, in 280 fathoms.

Remarks – This species is larger and more slender than either *okinavensis* or *luzonica*, but it is nearer in shape and sculptural details to *thielei* Finlay from which it differs in having three strong spiral keels instead of two, additional to the peripheral carina, which projects flange-like, in *thielei* and *philippinensis*, but not in either *okinavensis* or *luzonica*.

Description – Adult shell 43 to 50 mm. (about 1½ to 2 inches) in height, fusiform, with a spire tall yet broadly conic, with straight outlines, tabulated by the peripheral, broadly rounded, flange-like keel which is situated almost at the lower suture. Base rapidly contracted to a long-tapered, almost straight, anterior canal. Whorls 8 to 9, exclusive of protoconch, which is missing in all examples. Sculpture of spire whorls consists of 4 strong, flat-topped spiral keels with deeply channelled interspaces. The peripheral sinus rib projects as a flange beyond the other three. All four keels gemmate, those on the sinus keel stronger and more regular. Base, including the anterior canal, with 25 to 27 smooth spirals, those on the base rather strong, especially the upper two, but becoming weaker and more closely-spaced over the anterior canal. Spire three-fourths of the height of the aperture plus canal. Sinus broadly and shallowly V-shaped, descending in a straight slope at 30 degrees to the axis, then

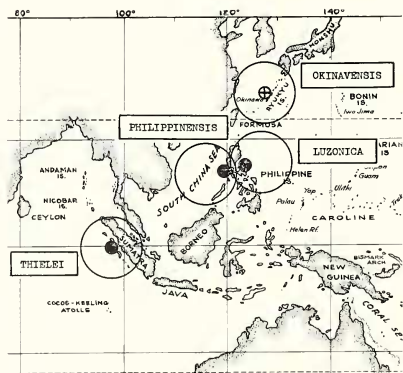


Plate 216. Geographical distribution of *Pinguicemmula okinavensis* MacNeil, *P. philippinensis* new species, *P. luzonica* new species, and *P. thielei* (Finlay).

produced tangentially forward at right angles. A paratype exhibits a massive tubular fluting in the form of a coalescence of the upper two basal spirals. It develops suddenly within 5 mm. of the outer lip edge and projects downward for 5 mm. as a partially closed tube. Colour pale yellowish buff. Parietal callus and interior of aperture white.

Measurements (mm.) —

height	width	spire angle	holotype
50.2	18.7	40°	
43.5	17.2	42°	

Types — The holotype is in United States National Museum, Washington, no. 237563.

Records — PHILIPPINES: off Santiago, west Luzon Id., Philippines, in 280 fms. (Albatross Sta. 5283, USNM, type locality).

Genus *Cryptogemma* Dall, 1918

(Pl. 217, fig. a)

Type: *Gemmula benthina* Dall, 1908

Shells of this genus are rather broadly fusiform but with a short twisted anterior canal. Weak axial ribs are produced into rounded nodules on a conspicuous peripheral keel. The sinus is at the periphery, rather slight and square-cut at the apex of a broadly open V. Apical whorls unknown. The outer shell is covered by a greenish grey periostracum. Operculum oval, with an apical nucleus. Radula of the "wishbone type." Recent, deep water, 1200 to 1300 fathoms, Gulf of Panama to Ecuador. Height, 10 to 30 mm.

This genus may later come into use for some at present undescribed species from deep water off Hawaii.

Synonymy —

1918 *Cryptogemma* Dall, Proc. U. S. National Mus. 54 (2238), p. 325. *Type* by monotypy: *Gemmula benthina* Dall, 1908.

Characteristic Species — *C. benthina* Dall, 1908; *quentinensis* Dall, 1919; *serilla* Dall, 1908.

Pinguicemulla thielei (Finlay, 1930)

(Pl. 215, fig. 7)

Range — Off west coast of Sumatra, Indonesia in 614 metres.

Remarks — This species and *philippinensis* are obviously closely allied, but unfortunately no examples of *thielei* are available to the writer. Assuming that Thiele's illustration is accurate, *thielei* differs from *philippinensis* in having two instead of three spiral keels in addition to the peripheral flange-like keel. Also, in Thiele's figure, only the peripheral keel is shown to be gemmate, whereas in *philippinensis* all four spiral keels are gemmate to some extent.

Measurements (mm.) —

height	width	spire angle	holotype
44.0	18.0	45°	

Synonymy —

1925 *Pleurotoma* (*Gemmula*) *fusiformis* Thiele, Wissenschaft. Ergebn. Deutschen Tiefsee-Exped. 17, Gastr. 2, p. 210, pl. 22, fig. 24 (non *Pleurotoma fusiformis* J. de C. Sowerby, 1823, non Anton, 1839, non C. B. Adams, 1850).

1930 *Gemmula thielei* Finlay, Trans. N. Z. Inst. 61, p. 47 (nom. nov. for *Pl. (Gemmula) fusiformis* Thiele, 1925).

Types — The type locality is off the west coast of Sumatra, "Valdivia" Sta. 194; 0° 15.2' N.; 98° 8.8' E., 614 metres.

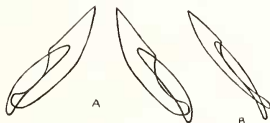


Plate 217. Radulae of (a) *Cryptogemma benthina* (Dall, 1908) and (b) *Carinoturris adraestia* (Dall, 1919). Both drawings prepared by J. P. E. Morrison, U.S. National Museum.

[These occasional blank areas occur between genera and subgenera to permit the insertion of new material and future sections in their proper systematic sequence.]

Genus *Carinoturris* Bartsch, 1944

(Pl. 217, fig. b)

Type: *Cryptogemma adrastra* Dall, 1919

Very similar to *Cryptogemma* in shape but with a plain narrowly rounded peripheral keel. Anal sinus at periphery, wide and shallow. Shell white, covered with a pale-olive periostracum. Protoconch of one smooth rounded whorl. Operculum small, broadly ovate with an apical nucleus. Radula of "wishbone" type. Height, 14 to 16 mm. Recent, deep-water, 300 to 600 fathoms off California.

Synonymy —

1944 *Carinoturris* Bartsch, Proc. Biol. Soc. Washington 57, p. 60. Type by original designation: *Cryptogemma adrastra* Dall, 1919.

Characteristic Species — *C. adrastra* Dall, 1919; *fortis* Bartsch, 1944; *polycaste* Dall, 1919.

Genus *Hemipleurotoma* Cossmann, 1889Type: *Pleurotoma archimedis* Bellardi, 1878

This name is based upon a very rare fossil from the Helvetian middle Miocene of Italy, but in 1896, Cossmann invalidly proposed *denticula* Basterot, 1825, as neotype of his genus, but the original citation must stand. Based upon this original type designation, about the only distinguishing characteristic of *Hemipleurotoma* is the very broadly open V-shaped sinus, otherwise it conforms with *Gemma*. Glibert (1960, p. 4) includes *Hemipleurotoma* in the synonymy of *Gemma*. The genus has been erroneously applied to the Recent *Turris cryptorrhaphes* (Sowerby, 1825).

Synonymy —

1889 *Hemipleurotoma* Cossmann, Ann. Soc. Malac. Belgique 24, p. 264. Type by original designation: *Pleurotoma archimedis* Bellardi, 1878; 1896, Essais de Paléontol. Comp. 2, p. 78. Type by subsequent designation [invalid]: *Pleurotoma denticula* Basterot, 1825.

Genus *Coronia* Gregorio, 1890Type: *Pleurotoma childreni* Lea, 1833

This is usually considered a synonym of *Gemma*, but Gardner, 1945 (Memoir no. 11, Geol. Soc. of America, p. 240) gave it full generic status upon the form of the protoconch, which is of two or more smooth, rapidly enlarging whorls, succeeded by one or more convex whorls sculptured with numerous obliquely arcuate costae. Smooth initial whorls, to a varying degree, however, occur among the Indo-Pacific Recent species of *Gemma*, and these minor deviations would appear to have no special significance. Claiborne Eocene of the southern United States and northern Mexico.

Synonymy —

1890 *Coronia* Gregorio, Ann. de Geol. et de Paléontologie, Palermo, 7, p. 23. Type by subsequent designation by Cossmann, 1896: *Pleurotoma acutirostra* Conrad — (fide Gardner, 1945, p. 240) *childreni* Lea, 1833. [*Coronia* Ehrenberg, 1840, Bericht Verh. Akad. Wiss. Berlin, p. 206, no. 106, is a Diatom and does not preoccupy *Coronia* Gregorio].

Characteristic species — *childreni* Lea, 1833; *genitiva* Casey, 1904; *margaritosa* Casey, 1904.

Genus *Trypanotoma* Cossmann, 1893Type: *Pleurotoma terebriformis* Meyer, 1886

A small shell with a very tall spire but truncated base. Protoconch blunt, of 2½ smooth whorls. Adult whorls almost flat in outline but with a median placed noduliferous peripheral weak carina. Sinus weak, peripheral. Claiborne and Jackson Eocene of Alabama and Louisiana.

Synonymy —

1893 *Trypanotoma* Cossmann, Essais de Paléont. Comp. 2, p. 109. Type by original designation: *Pleurotoma terebriformis* Meyer, 1886. Eocene.

Genus *Sinistrella* Meyer, 1887Type: *Triforis americanus* Aldrich, 1885

This genus is usually considered a sinistral form of *Trypanotoma* but Harris & Palmer (1947, p. 423) give it full generic status, but in association with *Coronia*, *Trypanotoma* and *Infracoronia*. Known apparently only from the type species, which is always sinistral and comes from the Jackson Eocene of Mississippi.

Synonymy —

1887 *Sinistrella* O. Meyer, Ber. Senckenb. naturf. Ges., for 1887, p. 18. Type by subsequent designation (Cossmann, 1893, p. 110): *Triforis americanus* Aldrich, 1885.

Subgenus *Infracoronia* Palmer, 1947Type: *Gemma indociciana* (Vaughan) Harris, 1896

This is compared with *Coronia* from which it is stated to differ in having the dentate carina at the base of each whorl, just above the suture, and the absence of a subsutural band. It was proposed, however, as a subgenus of *Sinistrella*. Lower Claiborne and Jackson Eocene of Louisiana, southern United States.

Synonymy —

1947 *Infracoronia* Palmer, in Harris and Palmer, Bull. Amer. Paleont. Inst., Ithaca, 30(117), Sec. 3, p. 423. Type by original designation: *Gemma indociciana* (Vaughan) Harris, 1896. Subgenus of *Gemma*.

Genus *Hesperiturris* Gardner, 1945

Type: *Turris nodocarinata* Gabb, 1860

This is another member of the *Gemmula* complex which was diagnosed primarily upon the form of the protoconch which was described as of 5 to 5½ volutions, the initial turn minute and largely immersed, the 3 to 3½ succeeding whorls also smooth and shining, broadly rounded, and increasing rather rapidly in diameter, the final whorl in whole or in part axially costate. The adult shell has a tall narrow spire but a truncated anterior canal. The sculpture is of nodules on a peripheral carina just above the lower suture. Sinus broadly U-shaped, moderately deep, the axis running closer to the periphery than to the posterior suture. The genus appears to be confined to the lower Claiborne Eocene of the southern United States and northern Mexico.

Synonymy —

1945 *Hesperiturris* Gardner, Memoirs no. 11, Geol. Soc. America, p. 237. Type by original designation: *Turris nodocarinata* Gabb, 1860.

Characteristic Species — *H. amichel* Gardner, 1945; *nodocarinata* Gabb, 1860; *zacatensis* Gardner, 1945.

Genus *Campylacrum* Finlay & Marwick, 1937

Type: *Campylacrum sanum* Finlay & Marwick, 1937

This is another member of the *Gemmula* assemblage, nearest to *Eoturris*, but of smaller size, different apex and a twisted canal. So far, it is known only from the Upper Cretaceous (Wangaloan) of New Zealand. There is apparent a relationship also with the Parisian Eocene *Oxyacrum* Cossmann; both have a small, conic, polygyrate protoconch, and a wide, moderately deep, bluntly triangular sinus, situated on the peripheral keel, with the apex of the sinus not encircling the peripheral nodules, but occurring immediately above them.

Synonymy —

1937 *Campylacrum* Finlay and Marwick, N. Z. Geological Survey Paleo. Bull. 15, p. 84. Type by original designation: *C. sanum* Finlay and Marwick, 1937.

Campylacrum debile Finlay & Marwick, 1937

Range — Wangaloa, South Island, New Zealand (Wangaloan, Upper Cretaceous).

Synonymy —

1937 *Campylacrum debile* Finlay & Marwick, N. Z. Geol. Surv. Paleo. Bull. 15, p. 86, pl. 12, figs. 1, 2.

Types — The holotype is in the Auckland Museum.

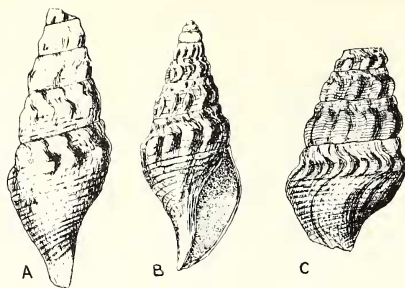


Plate 218. Figs. a and b, *Campylacrum sanum* Finlay and Marwick. Upper Cretaceous of Wangaloan, New Zealand (from the original, 1937, pl. 12, figs. 3, 4). Fig. c, *Eoturris multicinctus* (Marshall, 1917). Eocene: Bartonian of Castle Hill Shale (?) Otago, New Zealand (from Finlay and Marwick, 1937, pl. 16, fig. 2).

Campylacrum sanum Finlay & Marwick, 1937

(Pl. 218, figs. a, b)

Range — Wangaloa, South Island, New Zealand (Wangaloan, Upper Cretaceous).

Synonymy —

1937 *Campylacrum sanum* Finlay & Marwick, N. Z. Geol. Surv. Paleo. Bull. 15, p. 86, pl. 12, figs. 3, 4.

Types — The holotype is in the Auckland Museum.

Genus *Eopleurotoma* Cossmann, 1889

Type: *Pleurotoma multicostata* Deshayes, 1834

This is a Paleocene-Eocene relative of *Gemmula* in which the axial sculpture is in the form of long, narrow flexuous ribs which thicken at the periphery to form a row of laterally compressed oblique nodules.

The shell is 15 to 25 mm. in height, elongate-fusiform, but with a relatively short anterior canal. Protoconch small, smooth and paucispiral. Anal sinus broadly V-shaped, its apex extending a little above the peripheral nodules. It occurs in Europe, south western United States and Peru and is recorded also from the Tertiary of southern and south eastern Asia and Japan, but the species require re-evaluation.

Synonymy —

1889 *Eopleurotoma* Cossmann, Ann. Soc. Malac. Belgique 24, p. 269. Type by original designation: *Pleurotoma multicostata* Deshayes, 1834; 1906, Cossmann, Essais de Paléoconch. Comp. 7, pl. 14, fig. 16.

1904 *Eodrillia* Casey, Trans. St. Louis Academy 14, p. 159. Type by subsequent designation (Cossmann, 1904, p. 237): *Pleurotoma depygis* Conrad.

Characteristic Species — EUROPEAN EOCENE: *bernayi* Boury, 1899; *bezancoui* Boury, 1899; *bica-tentata* Lamarck, 1804; *cedilla* Edwards, 1861; *curvica* Lamarck, 1804; *distans* Deshayes, 1865; *distanticosta* Cossmann & Pissarro, 1900; *expedita* Deshayes, 1865; *flexicosta* Boury, 1899; *fluctuosa* Deshayes, 1865; *francisci* Raincourt, 1876; *fresvillensis* Cossmann & Pissarro, 1900; *granifera* Deshayes, 1834; *inculta* Sowerby, 1850; *iusucta* Boury, 1899; *lajonkairei* Deshayes, 1834; *larteti* Deshayes, 1865; *lima* Edwards, 1861; *multicostata* Deshayes, 1834; *multinoda* Lamarck, 1804; *oligocolpa* Cossmann, 1889; *plicaria* Deshayes, 1834; *pourcyensis* Cossmann, 1901; *propinqua* Deshayes, 1865; *rotella* Edwards, 1861; *rudiuscula* Cossmann, 1889; *scalarata* Edwards, 1861; *specialis* Boury, 1899; *spreti* Deshayes, 1865; *undata* Lamarck, 1804.

NORTH AMERICAN EOCENE: *adolcsens* Harris, 1937; *albirupsis* Harris, 1947; *cainei* Harris, 1937; *carya* Harris, 1937; *cochlea* Harris, 1937; *depygis* Conrad, 1833; *desuoyersii* Lea, 1833; *gem-mavia* Harris, 1937; *hoeninghausii* Lea, 1833; *lis-boncola* Harris, 1937; *nupera* Conrad, 1833; *orange-burgensis* Harris, 1937; *ouachiteusis* Harris, 1937; *plumbella* Harris, 1937; *politica* Harris, 1937; *rugatina* Harris, 1937; *rugosa* Lea, 1833; *sabiniaria* Harris, 1937; *sayi* Lea, 1833; *thyroidifera* Harris, 1937.

PERU: *paytensis* Olsson, 1930; *wiedeyi* Olsson, 1930.

EUROPEAN PALEOCENE: *selandica* Koenen, 1885.

Subgenus *Oxyacrum* Cossmann, 1889

Type: *Pleurotoma obliterata* Deshayes, 1834

Members of this subgenus are very similar to *Eopleurotoma* but have a tall, narrowly conical protoconch of 4½ smooth whorls, plus a whorl of brephic axials. It occurs in the Eocene of Europe and England.

Synonymy —

1889 *Oxyacrum* Cossmann, Ann. Soc. Malac. Belgique 24, p. 274. **Type** by original designation: *Pleurotoma obliterata* Deshayes, 1834; 1896, Cossmann, Essais de Paléoconch Comp. 2, p. 82.

Characteristic Species — *E. constricta* Edwards, 1861; *contabulata* Deshayes, *inflexa* Lamarck, 1804; *lepta* Edwards, 1861; *obliterata* Deshayes, 1834.

Genus *Eoturris* Finlay & Marwick, 1937

Type: *Turris complicata* Suter, 1917

This is a New Zealand genus ranging from the Eocene (Bortonian) to the Upper Oligocene (Wai-takian). It belongs to the *Gemma* series but has a considerably broader sinus, spreading above the peripheral keel on to the shoulder as in *Eopleurotoma* from the European and North American Eocene. However, *Eopleurotoma* is distinct in having a paucispiral protoconch, a short, gently twisted neck and usually a distinct fasciole. The protoconch in *Eoturris* is narrow, elongate-conic, with the axials restricted to the last quarter whorl, instead of being numerous and spread over the last two or three whorls as in *Gemma*.

Synonymy —

1937 *Eoturris* Finlay and Marwick, New Zealand Geol. Survey Paleol. Bull. 15, p. 114. **Type** by original designation: *Turris complicatus* Suter, 1917.

Eoturris complicata (Suter, 1917)

Range — New Zealand Bortonian, Eocene.

Synonymy —

1917 *Turris complicatus* Suter, N. Z. Geol. Surv. Paleol. Bull. 5, p. 45, pl. 5, fig. 14.

1917 *Surcula mordax* Suter, N. Z. Geol. Surv. Paleol. Bull. 5, p. 51 (non Martin, 1915).

1942 *Eoturris complicatus* Suter, Powell, Bull. no. 2, Auckland Inst. Mus., p. 46.

Types — The type locality is McCullough's Bridge, South Canterbury, New Zealand. The holotype is in the New Zealand Geological Survey, Wellington, New Zealand.

Eoturris multicincta (Marshall, 1917)

(Pl. 218, fig. c)

Range — New Zealand Bortonian, Eocene.

Synonymy —

1917 *Turris multicinctus* Marshall, Trans. N. Z. Inst. 49, p. 456, pl. 36, fig. 34.

1942 *Eoturris multicinctus* Marshall, Powell, Bull. no. 2, Auckland Inst. Mus., p. 46.

Types — The type locality is "Wangaloa," probably Castle Hill Shaft. The holotype is in the Otago University Museum, Dunedin, New Zealand.

Eoturris neglecta (Suter, 1917)

Range — New Zealand Bortonian, Eocene.

Synonymy —

1917 *Turris neglectus* Suter, N.Z. Geol. Surv. Pal. Bull. 5, p. 46, pl. 6, fig. 1.

1924 *Turris insensu* Finlay, Proc. Mal. Soc., 16, p. 103 (nom. nov. for *neglectus* Suter, 1917, non *Pleurotoma neglecta* Reeve, 1842; new name unnecessary).

1942 *Eoturris neglectus* Suter, Powell, Bull. no. 2, Auckland Inst. Mus., p. 46.

Types — The type locality is N.Z.G.S. loc. 630 probably McCullough's Bridge, South Canterbury. The holotype is in the N.Z. Geological Survey.

Eoturris uttlei (Suter, 1917)

Range — New Zealand Waitakian, Upper Oligocene.

Synonymy —

1917 *Turris uttlei* Suter, N. Z. Geol. Surv. Paleo. Bull. 5, p. 47, pl. 6, fig. 2.

1942 *Eoturris uttlei* Suter, Powell, Bull. no. 2, Auckland Inst. Mus., p. 47.

Types — The type locality is Otiake, Waitaki Valley, North Otago, New Zealand.

Genus *Epalxis* Cossmann, 1889

Type: *Pleurotona crenulata* Lamarck, 1803

This European Eocene genus was compared with *Bathytoma* by its author, and, later, Glibert (1960) preserved the association by making *Bathytoma* a subgenus of *Epalxis*. Nevertheless, *Epalxis* seems

to fall more naturally into the series of *Eopleurotoma*, *Eoturris* and *Oxyacrum*. The genus *Bathytoma* by reason of its characteristic columellar callosity seems to have more in common with the Borsoniinae. Also the radula of *Bathytoma* and *Micantapex* do not have the characteristic "wish-bone" marginals of the typical Turrinae but slender awl-shaped ones of toxoglossate style. *Epalxis* closely resembles *Eopleurotoma* in adult features and in having a paucispiral protoconch. The chief diagnostic features are the very broadly open anal sinus which occupies most of the spire whorls from suture to suture, and its broadly rounded apex which is wider than the broadly rounded periphery and which bears strong laterally compressed crescentic nodules.

Synonymy —

1889 *Epalxis* Cossmann, Ann. Soc. Malac. Belgique 24, p. 254. *Type* by original designation: *Pleurotona crenulata* Lamarck, 1803; 1896 Cossmann, Essais de Paléoconch. Comp., 2, p. 103.

Characteristic Species — *E. bilirata* Boury, 1899; *crenulata* Lamarck, 1803; *lemoinei* Boury, 1899; *multigyrata* Deshayes, 1865; *centricosa* Lamarck, 1804.

Genus *Lucerapex* Iredale, 1936

Type: *Pleurotoma cascaria* Hedley & Petterd, 1906

Members of this genus are rather small elongate-fusiform shells, with a very tall spire and moderately long canal, of light build, and rather simple sculpture of a peripheral row of scale-like to tubercular nodes on an angulation or a raised keel. The sinus is peripheral, broadly open, rather shallow, U-shaped and defined over the whole shell in the form of distinct axial growth lines. The protoconch is small, smooth, paucispiral and globular, ending in up to a quarter whorl of protractively arcuate thin axials.

This genus has a wide Indian Ocean distribution in deep water extending from the Gulf of Aden down the East African Coast, through Indonesian waters to the Philippines, and then southward to off the coast of New South Wales. It is represented also in the Quaternary of Timor and the Miocene of South Australia.

This genus seems to be most nearly related to *Fusiturris* which has a Recent range extending from the Mediterranean to West Africa and has European fossil relatives reaching back to as early as the Paleocene.

Both *Fusiturris* and *Lucerapex* are of elongate-fusiform shape, have the same peripheral nodulation, as well as a rather shallow, broadly open, U-shaped sinus which is defined over all post-embryonic whorls by crisp axial growth lines. The protoconch in *Fusiturris* is, however, narrowly conic and of about three whorls, and the shell is, for the most part, larger and of more solid build.

It is confidently assumed that *Lucerapex* is an Indo-Pacific product developed from *Fusiturris*, in isolation, after the closing of that great equatorial waterway of the past, the Tethys Sea.

Synonymy —

- 1936 *Lucerapex* Iredale, Records Australian Mus. 19, p. 337. Type by original designation: *Pleurotoma cascaria* Hedley and Petterd, 1906.

Lucerapex casearia (Hedley & Petterd, 1906)

(Pl. 219)

Range — Known only from 300 fathoms and 800 fathoms off Sydney, New South Wales, Australia.

Description — Shell small, 13 mm. ($\frac{1}{2}$ inch) in height, thin, elongate-fusiform, with a tall spire and a long, slightly flexed, spout-like anterior canal.

Protoconch paucispiral with glassy, rounded, smooth whorls. Spire whorls prominently angled at about the lower third by a narrowly rounded keel, produced into regular blunt tubercles, 18 on the penultimate whorl. Sinus on the peripheral keel, of moderate depth, narrowly rounded at the base of a broad U-shaped area. Surface smooth, except for fine axial growth lines which diverge acutely both above and below the keel. Colour varying from pearl-grey to pale-orange (probably due to staining).

Measurements (mm.) —

height	width	
13.0	5.0	holotype

Synonymy —

- 1906 *Pleurotoma cascaria* Hedley & Petterd, Rec. Aust. Mus. 6, p. 220, pl. 37, fig. 5.
1936 *Lucerapex cascaria* H. & P., Iredale, Rec. Aust. Mus. 19(5), p. 320.
1954 *Lucerapex cascaria* H. & P., Lasearon, The N. S. W. Turridae, Roy. Zool. Soc. N. S. W. Handb., p. 8, pl. 1, fig. 15.

Types — The holotype is in the Australian Museum, Sydney.

Records — NEW SOUTH WALES: 300 fms. (type locality) and 800 fms. off Sydney.

Lucerapex casearia subsp. nov. *regilla* Iredale, 1936

Remarks — Iredale separated shells from 110 fathoms off Sydney, stating that they were much larger than typical 300 fathom shells, and exhibited wavy lines below the periphery, a feature absent in the typical species. This may be merely an ecologic form.



Plate 219. *Lucerapex cascaria* (Hedley & Petterd). Holotype, 300 fms., off New South Wales, Australia (from Hedley and Petterd, 1906, pl. 35, fig. 5).

Measurements (mm.)—

height	width	
21	—	holotype

Synonymy—

1936 *Lucerapex cascaria regilla* Iredale, Rec. Aust. Mus. 19(5), p. 320.

Types—The holotype is in the Australian Museum, Sydney.

Records—NEW SOUTH WALES: 110 fms. off Sydney (type locality).

Lucerapex denticulata (Thiele, 1925)

(Pl. 220, fig. 2)

Range—Off Somaliland, East Africa and the Gulf of Aden, 732 to 1270 metres.

Remarks—This species is characterised by the simplicity of its sculpture which consists of a row of stout pointed tubercles on a sharp peripheral angle set just below the middle whorl height. The rest of the shell is smooth. It is closer to *carola* Thiele, 1925, than to the type of the genus, *cascaria* Hedley & Petterd, 1906, from which it differs in having fewer tubercles on the peripheral keel.

There is a prior *Pleurotoma* (*Mangelia*) *denticulata* Smith, 1884, but Thiele's species is not re-named since it is doubtfully distinct from *carola* of the same author.

Measurements (mm.)—

height	width	
19.2 +	7.0	Gulf of Aden, 1270 metres
13.0	4.5	holotype

Synonymy—

1925 *Pleurotoma denticulata* Thiele, Wissenschaft. Ergebn. Deutschen Tiefsee-Exped. 17, Gastr. 2, p. 216, pl. 24, fig. 2.

Records—SOMALILAND: 1° 49' N., 45° 29.5' E., 1134 metres (type locality). GULF OF ADEN: 14° 36' 06" N., 51° 00' 18" E., 1270 metres, Sta. 184; 12° 04' 06" N., 50° 38' 36" E., 732 metres, Sta. 176 (John Murray Exped., Brit. Mus.).

Lucerapex carola (Thiele, 1925)

(Pl. 220, fig. 1)

Range—Off Somaliland, East Africa, 693 metres.

Remarks—This species is known to the writer only from the original figure and description. It seems to be very closely allied to, if not identical with, the same author's *denticulata*. From the figure, the only apparent difference observed is in the form of the peripheral tubercles, which are rounded in *carola* but square-cut in *denticulata*. However, this small difference in sculpture could be resultant from the fact that *carola* appears to be not fully grown.

One refrains from uniting *carola* and *denticulata* without seeing the type material, for there may be matters of minor sculpture and texture that are not revealed in either the descriptions or the figures.

Measurements (mm.)—

height	width	
9.0	3.2	holotype

Synonymy—

1925 *Pleurotoma carola* Thiele, Wissenschaft. Ergebn. Deutschen Tiefsee-Exped. "Valdivia" 17, Gastr. 2, p. 216, pl. 24, fig. 3.

Lucerapex adenica new species

(Pl. 221, fig. 3)

Range—Gulf of Aden, 274 to 1080 metres.

Remarks—This species has a more slender spire than *molengraaffi*, larger peripheral nodules than in any of the other species of the genus, an unusual feature in the presence of weak subsutural gemmules, and numerous weak spirals on the base and anterior end. The peripheral nodules spread across and beyond a broadly rounded peripheral keel. In *molengraaffi* the nodules are restricted to a narrow, sharp-edged, peripheral keel, and to a less degree this is the case with *cascaria*. In *denticulata* and *carola* the nodules are in the form of pointed tubercles on a simple peripheral angle.

Description—Shell 25 to 32 mm. (1 to 1½ inches) in height, narrowly fusiform, with a very tall slender spire, and a moderately long slightly twisted anterior canal. Spire 1.3 times the height



Plate 220. Fig. 1, *Lucerapex carola* (Thiele). Fig. 2, *L. denticulata* (Thiele). Both holotypes. Both deep-water, off East Africa (from Thiele, 1925, pl. 24). Figs. 3, 4, *Lucerapex molengraaffi* (Tesch). Pliocene of Timor Id., Indonesia (from Tesch, 1915, pl. 77).

of the aperture plus canal; spire angle 20° . Whorls 11.5, including a small paucispiral protoconch of 1.5 whorls, tip asymmetric and inrolled, last $\frac{1}{4}$ whorl of arcuate, breplic, axial threads. Spire whorls with a massive, rounded, median peripheral keel which occupies more than one-third of the whorl height; sculptured with heavy crescentic axials, 15 on the penultimate whorl. A row of weak subsutural gemmules is present. Base with 4 widely spaced, weak spirals on the upper part of the base, with only the uppermost emergent over the spire whorls; remainder of base with linear spaced, weak spirals. Sinus peripheral, broadly U-shaped, its scar clearly marked over all the post-nuclear whorls by strong axial growth lines. Colour pure white.

Measurements (mm.)—

height	width	
30.8	8.0	holotype
29.7	8.0	
23.7	7.0	

Types—The holotype is in the British Museum (Natural History).

Records—GULF OF ADEN: $13^\circ 05' 36''$ N., $46^\circ 24' 42''$ E., 1022 metres, Sta. 34 (type locality); $13^\circ 06' 12''$ N., $46^\circ 24' 30''$ E., 1061-1080 metres, Sta. 193; $13^\circ 46' 30''$ N., $47^\circ 48' 54''$ E., 274 metres, Sta. 191 (John Murray Exped., Brit. Mus.).

Lucerapex indagatoris (Finlay, 1927)

(Pl. 221, figs. 4, 5)

Range—Off South India, 360 to 430 fathoms.

Remarks—This species is difficult to place generically without having seen specimens. It would seem, however, on the basis of the published description and figures, to have more claim for inclusion in *Lucerapex* than in *Gemmula*. The nature of the peripheral nodulation and in particular the subsutural series of weak gemmules indicate a shell fairly close to *adenica new species*, but differing chiefly in the low-set position of the peripheral carina. Unfortunately, the apical whorls are unknown.

Measurements (mm.)—

height	width
36.0	10.0

Synonymy—

- 1899 *Pleurotoma optata* E. A. Smith, Ann. Mag. Nat. Hist., Ser. 7, 4, p. 238.
 1909 *Pleurotoma optata* E. A. Smith, Annandale & Stewart, Illust. Zool. Investigator, Moll., pl. 9, figs. 1, la.
 1927 *Gemmula indagatoris* Finlay, Trans. N. Z. Inst. 57, p. 517, nom. nov. for *Pl. optata* Smith, 1899 (non *Pl. optata* Harris, 1897).

Types—The type is in the Indian Museum, Calcutta.

Records—INDIA: off the south coast, 430 fms. (type locality); off Travancore, 360 fms. (E. A. Smith).

Lucerapex molengraaffi (Tesch, 1915)

(Pl. 220, figs. 3, 4; pl. 221, figs. 1, 2)

Range—Quaternary of Timor and the Recent of Borneo, Celebes and the Philippines, 254 to 559 fathoms.

Remarks—This species which was described from the Quaternary of Timor is identical with Recent deep-water material from "Albatross" dredgings taken in the vicinity of Borneo, Celebes and the Philippines.

From the other species of the genus it differs in having a square-cut, peripheral flange bearing the nodules, which later become scale-like, and in having distinct spiral threads on the base.

Description—Adult shell 30 to 33 mm. (about 1 inch) in height, elongate-fusiform with a tall spire and a long, flexed canal with a spout-like termination; light build; and prominently and medially carinated by a square-cut raised flange bearing regular, closely spaced, squarish nodules, 15 or 16 on the penultimate whorl, but becoming crowded and scale-like over the last half-whorl. Spire slightly greater than the height of the aperture plus canal; spire angle 20° to 22° . Whorls 10, including a small, smooth, globular protoconch of two whorls.



Plate 221. Figs. 1, 2, *Lucerapex molengraaffi* (Tesch). 254 fms., off west Siquijor Id., Philippines. 32 mm. Fig. 3, *Lucerapex adenica* new species, Holotype, 1,022 metres, Gulf of Aden. 30.8 mm. Figs. 4, 5, *Lucerapex indagatoris* (Finlay). Holotype of *Pleurotoma optata* E. A. Smith, 1899, non Harris, 1897. 430 fms., off south coast of India (from Annandale and Stewart, 1909, pl. 9, figs. 1, la).

Sinus wide, shallow, U-shaped, and on the peripheral carina. Two, sometimes three, weak wavy spiral threads encircle the upper base. Axial growth lines strong, especially on the base.

Measurements (mm.)—

height	width	
30.25	10.0	
29.0	8.2	Borneo, 305 fms.
28.5	8.7	Noil Tobe, Timor, Pliocene
25.0	8.0	

Synonymy—

1915 *Pleurotoma* (s. str.) *Molengraaffi* Tesch, Palaont. von Timor 5(9), Jungtref. und Quartäre, Moll. von Timor, p. 28, pl. 77, figs. 54-56.

Records—TIMOR: Pliocene (type locality); Noil Tobe (Pliocene) (Brit. Mus.). BORNEO: off Silungan Id. 305 fms., Sta. 5592; off Sipaden Id., Sibuko Bay, 347 fms., Sta. 5586. CELEBES: Buton Strait, 559 fms., Sta. 5648. PHILIPPINES: west of Siquijor, 254 fms., Sta. 5537 (Albatross USNM).

Lucerapex murrayana (Pritchard, 1904)

Range—Balcombian, Miocene, in Victoria, Australia.

Remarks—No specimens of this species have been examined by the writer but the description and not very distinct figure suggest that it belong to *Lucerapex*.

Description (from the original)—“Shell small to medium size with a rather blunt apex, slender elongate spire and a body whorl shorter than the spire. Embryo consisting of about 2½ whorls, blunt apically, smooth and inclined to be angled medially after about the first half turn; this portion is also rather more tumid and protrudes over the remainder of the embryonic whorls; whorls strongly nodosely keeled about the middle of each whorl and forming a well marked shoulder on the body whorl. The keel marks the position of the sinus and is very regularly and acutely nodulose, nodules about 18 to 20 on the penultimate and body whorls. Outer lip thin and sharp, with a broad deep sinus at the shoulder.”

Measurements (mm.)—

height	width	
28.0	9.0	holotype

Synonymy—

1904 *Pleurotoma murrayana* Pritchard, Proc. Roy. Soc. Victoria 17, p. 335, pl. 19, fig. 10.

1944 *Lophiotoma murrayana* Pritchard, Powell, Rec. Auck. Inst. Mus. 3(1), p. 9.

Records—AUSTRALIA: River Murray Cliffs near Morgan, Victoria (Balcombian, Miocene).

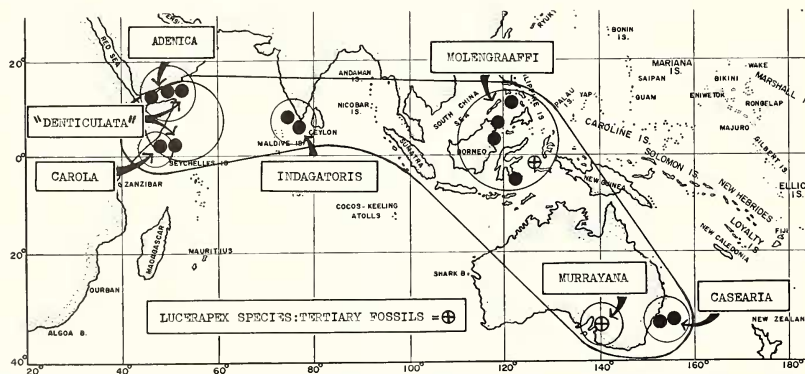


Plate 222. Geographical distribution of *Lucerapex casearia* (Hedley and Petterd), *L. molengraaffi* (Tesch), *L. carola*

(Thiele), *L. denticulata* (Thiele), *L. indagatoris* (Finlay), *L. adenica* new species, and *L. murrayana* (Pritchard).

Genus *Ptychosyrinx* Thiele, 1925

Type: *Pleurotoma (Subulata) bisinuata* Martens, 1901

This is a deep-water genus strongly resembling *Gemmula*, except for the sinus which, although situated on the gemmate peripheral carina, is not deep and narrow, but broadly V to U shaped at its apex and not very deep. Unfortunately the apical whorls, except in the type species, are eroded away in all examples so far examined. Thiele (1925, pl. 23, fig. 4) showed the protoconch of *bisinuata* as narrowly conic with four axially costate whorls.

The radula in the type species, *bisinuata*, figured by Thiele (1929, p. 359, fig. 436) is unlike that of *Gemmula*, in that a large rectangular-based central tooth is present in addition to marginals, similar to the "wishbone" type of typical *Gemmula*. It could be considered prototypic of the Turrinae, comparable with the situation in the Clavinae where certain genera, *Drillia*, *Clavus* and *Spirotropis* for example, preserve a prototypic radula of central, lateral and marginal teeth. Most of the members of the subfamily Clavinae have a toxoglossate type of dentition consisting only of a pair of slender marginals.

The type species, *bisinuata*, as the name indicates, exhibits a spout-like projection of the lower outer lip as well as an anal siphonal notch. This same feature occurs in an example of *timorensis teschi* new subspecies from deep water in the Gulf of Tomini, Celebes, but it is not a constant feature of that subspecies. It results from a fusing and fluting of the two main basal cords.

The genus *Ptychosyrinx* is evidently of very wide distribution in the deep-sea basins, for apart from the East African and Indonesian occurrences it has been recorded recently from deep water off Bermuda, as *Bathybermudia carynae* Haas, 1949. Haas' genus was proposed under the mistaken impression that the bisinuate character of the type specimen of *Ptychosyrinx* was a diagnostic character of that genus.

Since this is now shown not to be the case, *Bathybermudia* falls as a synonym of *Ptychosyrinx*.

Synonymy —

- 1925 *Ptychosyrinx* Thiele, Wissenschaft, Ergebnisse Deutschen Tiefsee-Exped. 17(2), p. 210. Type by original designation (fide Powell, 1942, p. 20): *Pleurotoma bisinuata* Martens, 1901.
1949 *Bathybermudia* Haas, Bull. Inst. Catalana d'Hist. Nat., 37, p. 70. Type by monotypy: *B. carynae* Haas, 1949.

Ptychosyrinx bisinuata (Martens, 1901)

(Pl. 223, figs. 1, 2)

Range — Off East Africa, Somaliland to Zanzibar, 518 to 1362 metres.

Remarks — Shell tall-spined but with a rather short and recurved anterior canal. Protoconch polygyrate, narrowly conic, with 4 densely, axially costate whorls. Spire whorls sculptured with a broadly rounded, median carina studded with prominent, laterally compressed nodules. Spiral sculpture consisting of 2 or 3 threads between the upper suture and the peripheral carina, 2 or 3 threads below the carina and 3 strong, smooth cords on the upper part of the base, followed by about 9 threads over the neck and anterior canal. The uppermost of the 3 main basal spirals is emergent over the last whorl. The bisinuate nature of the outer lip exhibited by the type specimen has been shown above to be an abnormality. Colour pale yellowish.



Plate 223. Figs. 1, 2, *Ptychosyrinx bisinuata* Martens. Holotype. 1,134 meters, off East Africa. Figs. 3, 4, *Ptychosyrinx timorensis* (Tesch). Pliocene of Timor Id., Indonesia (from Tesch, 1915, pl. 77, figs. 53a, b). Figs. 5, 6, *Ptychosyrinx timorensis teschi* new subspecies. 415 fms., northwest of Sipadan Id., Borneo. Fig. 5, holotype, 47 mm. Figs. 7, 8, *Ptychosyrinx truncata* (Schepman). 2,798 meters, Banda Sea, Indonesia (from Schepman, 1913, pl. 26, fig. 1). 19 mm.

Measurements (mm.)—

height	width
33.0	11.5
30.0	9.0

Synonymy—

- 1901 *Pleurotoma (Subulata) bisinuata* Martens, Sitzungsberichte Gesellsch. nat. Freunde, Berlin, p. 17.
 1903 *Drillia (Subulata) bisinuata* Martens, Gast. Deutsch. Tiefsee-Exped., 1898-1899, 7, p. 82, pl. 1, fig. 8.
 1925 *Ptychosyrinx bisinuata* Martens, Thiele, Wissenschaft. Ergebn. Deutschen Tiefsee-Exped. 17, Gastr. 2, p. 210.

Records—EAST AFRICA: 1° 49' N., 45° 29' E., 1134 metres and 2° 58' N., 46° 50' E., 1362 metres; off coast of Somaliland, 6° 18' N., 49° 32' E., 1079 metres; Pemba Channel, Zanzibar, 818 metres (Martens).

Ptychosyrinx lobata (Sowerby, 1903)

(Pl. 224)

Range—Off Natal and South Africa, 300 to 900 fathoms.

Remarks—Superficially this shell looks identical with *Ptychosyrinx bisinuata* (Martens, 1901), a deep water East African species. Tomlin added a remark to the type tablet of *lobata* in the British Museum, claiming that it is synonymous with Martens's species, but one hesitates to accept this opinion, in view of Barnard's (1958) remarks on the very different nature of the radula in topotypes of *lobata*.



Plate 224. *Ptychosyrinx lobata* (Sowerby, 1903). Holotype from the British Museum (Natural History). 440 fms., off Cape Natal, South Africa. 31 mm.

Thiele (1929, p. 359) figured a radula for *bisinuata*, which has a very large unicuspid rectangular-based central in addition to a pair of marginals. However, in all the *lobata* specimens examined by Barnard, the central tooth of the radula was found to be missing. The radula of an East London specimen was described as "with c. 75 pairs of teeth, no central plate, laterals broadly cuneiform, one margin sharply angular (in edge view) no appendage" (his "lateral" tooth should read "marginal").

Unfortunately none of Barnard's specimens had the protoconch intact, nor was it preserved in Sowerby's holotype. The operculum is described by Barnard as oval, with an apical nucleus, again discordant with Thiele's "eiformig konzentrisch."

In the face of the above evidence *lobata* and *bisinuata* cannot be considered conspecific, probably not even congeneric, but for the present, *lobata* is included in *Ptychosyrinx* until more is known concerning its type species.

The thought arises that Thiele could have mixed up his radula preparations, for the type of radula he figured for *bisinuata* is of similar style to that of both *Aforia magnifica* Strebel and *Turridrupa jubata* Hinds, both of which have a large-based, unicuspid central tooth.

Measurements (mm.)—

height	width
31	11

Synonymy—

- 1903 *Pleurotoma (Surcula) lobata* Sowerby, Marine Invest. South Africa 2, p. 213, pl. 4, fig. 9.
 1958 *Turris lobata* Sowerby, Barnard, Ann. South African Mus. 44, p. 107; 1963, Ann. South African Mus. 46, p. 419.

Types—The type is in the British Museum (Natural History).

Records—SOUTH AFRICA: Cape Natal, N. by E., 24 mi., 440 fms. (type locality); Buffalo River, N. 15 mi., 310 fms. (Sowerby); off Cape Point, 380-900 fms. (Barnard).

Ptychosyrinx timorensis subspecies
timorensis (Tesch, 1915)

(Pl. 223, figs. 3, 4)

Range—Pliocene of Timor Island, Indonesia.

Remarks—The known examples of this species also lack the apical whorls but the adult shell, judged from Tesch's figures, closely resembles a Recent Indonesian deep-water shell described below. The Timor fossil is more slender than either *bisinuata* or the Recent Indonesian subspecies and the peripheral sculpture is of rounded rather than the laterally compressed nodules of *bisinuata*.

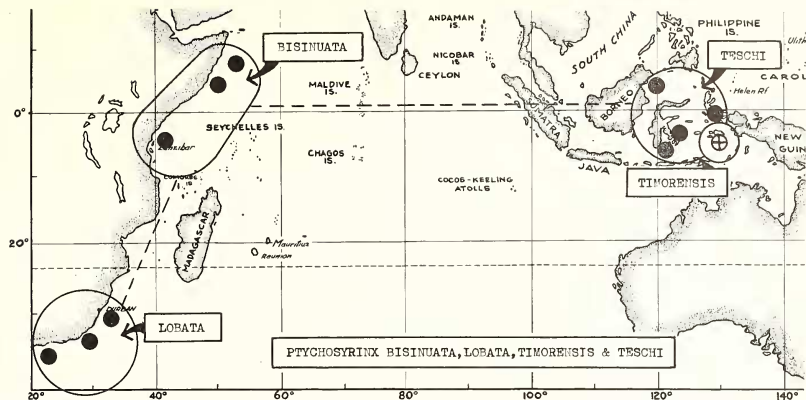


Plate 225. Geographical distribution of *Ptychosyrinx bisinuata* (Martens), *P. lobata* (Sowerby), *P. timorensis timorensis* (Tesch), and *P. timorensis teschi* new subspecies.

Measurements (mm.)—

height	width	
32-54	—	Tesch
53.0	17.5	from Tesch's fig. 53b

Synonymy—

1915 *Pleurotoma* (s. str.) *timorensis* Tesch, Palaent. von Timor, p. 27, pl. 77(5), figs. 52, 53.

Types—The type locality is Timor Island, Pliocene.

Ptychosyrinx timorensis subspecies teschi new subspecies

(Pl. 223, figs. 5, 6)

Range—Indonesia, Celebes, Moluccas and Borneo, 347 to 559 fms.

Remarks—This subspecies appears to be the direct Recent descendant of the Pliocene *timorensis*. It differs from that species mainly in being proportionately broader, resulting in a greater spire angle, in having a shorter spire and a more capacious body whorl.

Description—Adult shell 46 to 53 mm. (about 2 inches) in height, with a tall spire but a short and flexed anterior canal. Colour uniformly dull white. Whorls 9 to 10½, exclusive of the embryonic whorls which are missing in all specimens examined. Spire whorls sculptured with a strong subsutural cord

and a weaker spiral above it, the latter forming the margin of the suture. There are 2 or 3 threads between the subsutural cord and the peripheral carina. The latter is studded with closely-spaced, prominent, squarish nodules, 18 to 22 per whorl, obscurely overridden by 3 flat-topped linear-spaced spirals. Two spiral threads and one primary cord are between the peripheral carina and the lower suture. Base with 2 or 3 strong spiral cords above, and 8 or 9 spiral threads below on the neck and anterior canal. Spire about 1.3 times the height of the aperture plus canal; spire angle 30° to 33°. Sinus broadly V-shaped, relatively shallow, with a broadly rounded apex at the peripheral sinus angulation. Operculum leaf-shaped with an apical nucleus.

In *timorensis timorensis* the spire angle is 24° to 25°, and the height of the spire is almost twice that of the aperture plus canal.

An example from the Gulf of Tomini, Celebes (Albatross Sta. 5601) exhibits the "bisinate" abnormality of a second situation of the outer lip caused by the fusing and fluting of the two main basal cords.

Measurements (mm.)—

height	width	
53.7	17.0	Albatross Sta. 5586; Borneo
53.0	18.7	Albatross Sta. 5648; Celebes
47.0	17.0	holotype, Albatross Sta. 5587

Types—The holotype is in the United States National Museum, Washington, D. C. The type locality is at the Albatross Station 5587, N.W. of Sipadan Id., Borneo, in 415 fms. USNM no. 239068

Records — CELEBES: off North Id., Buton Strait, 519 fms., green mud (Albatross Sta. 5647); off North Id., Buton Strait, 559 fms., green mud (Albatross Sta. 5648); Gulf of Boni, 15 mi. S.E. of Tg. Olang, 484 fms., grey mud (Albatross Sta. 5656); Gulf of Tomini, (Albatross Sta. 5601). MOLUCCAS: March Id., Molucca Pass, 417 fms., grey mud (Albatross Sta. 5618). BORNEO: E. of Sipadan Id., Sibuko Bay, 347 fms., green mud (Albatross Sta. 5586); N.W. of Sipadan Id., 415 fms., green mud, sand and coral (holotype, Albatross Sta. 5587), (all USNM).

Ptychosyrinx truncata (Schepman, 1913)

(Pl. 223, figs. 7, 8)

Range — Known only from the Banda Sea, Indonesia.

Remarks — All four specimens mentioned by Schepman are lacking their upper whorls, and

without knowledge of the protoconch the generic location of this species is conjectural. The broadly open, shallow peripheral sinus and rather short anterior canal suggest location in *Ptychosyrinx* rather than in *Gemmula*. Sculpture consisting of strongly-waved, axial, fold-like ribs becoming weaker over the last whorl, and crossed throughout by numerous spiral threads.

Measurements (mm.) —

height	width
19 +	8

Synonymy —

1913 *Pleurotoma* (*Gemmula*) *truncata* Schepman, Siboga Exped., Monog. 49(1)c, p. 404, pl. 26, fig. 1.

Records — INDONESIA: Banda Sea, 2798 metres (type locality).

Subgenus *Kuroshioturris* Shuto, 1961

Type: *Gemmula* (*Kuroshioturris*) *hyugaensis* Shuto, 1961

When Shuto proposed this subgenus he associated it with *Gemmula* because of its similar sculpture and sinus. However, the smooth, globose paucispiral protoconch of *Kuroshioturris* suggests that it is more closely related to *Ptychosyrinx*, rather than to *Gemmula* which has a multispiral, axially costate protoconch.

The species from the Upper Miocene-Lower Pliocene of Japan described as *Gemmula* (*Ptychosyrinx*) *nipponicus* Shuto, 1961, seems to fit better into his subgenus *Kuroshioturris*. The protoconch is described as rather large and composed of a depressed, rounded and smooth first volution and a convex and inflated second one, which is smooth except for the last quarter whorl with brephic axials. His figure of the protoconch, however, gives the impression that the embryo terminates abruptly with the commencement of adult sculpture.

Synonymy —

1961 *Kuroshioturris* Shuto, Mem. Faculty Sci., Kyushu Univ., Series D, Geol. 11(2), p. 83. Subgenus of *Gemmula*; type by original designation: *G. (K.) hyugaensis* Shuto, 1961.

Ptychosyrinx nipponica (Shuto, 1961)

(Pl. 226, figs. 3, 4)

Range — Japan, near Yamaji (Upper Miocene-Lowest Pliocene).

Remarks — This shell closely resembles typical *Ptychosyrinx* in its adult facies, recalling *timorensis teschi* new subspecies, but with greater simplicity of sculpture, having a peripheral row of stout but more distant nodules and 2 very prominent spiral cords on the upper base. The only other spiral sculpture consists of weak threads, several submarginating the suture and a number on the neck and anterior canal. There is a tendency toward "bisinuation" of the outer lip at the termination of the upper basal cords.

Measurements (mm.) —

height	width
12.9	7.2
12.2	7.5
11.1	6.3

Synonymy —

1961 *Gemmula* (*Ptychosyrinx*) *nipponicus* Shuto, Mem. Fac. Sci. Kyushu Univ. Ser. D, Geol. 11(2), p. 81, pl. 3, figs. 7, 8, 13, 19; pl. 8 (not 7), fig. 14, text figs. 3, 4.

Records — JAPAN: entrance cutting to tunnel, 400 metres north of Yamaji, Mino mura, Koyu gun, Miyazaki Prefecture (Kawabaru member, lower Takanabe member, lower Upper Miocene to Lowest Pliocene) (type locality).

Ptychosyrinx hyugaensis (Shuto, 1961)

(Pl. 226, figs. 1, 2)

Range — Japan, Miyazaki Prefecture (Lowest Pliocene).

Remarks — The early whorls have a peripheral carina studded with rounded nodules but these become obsolete over the body whorl. The basal cords are also obsolete to subobsolete but are represented by an angulation. A blunt biangulation of the body whorl results.



Plate 226. Figs. 1, 2, *Ptychosyrinx* (*Kuroshioturris*) *hyugaensis* (Shuto). Lower Pliocene of Miyazaki Pref., Japan (from Shuto, 1961, pl. 3, figs. 2, 3). Figs. 3, 4, *Ptychosyrinx nipponica* (Shuto). Lowest Pliocene of Miyazaki Pref., Japan (from Shuto, 1961, pl. 3, figs. 7, 8).

Measurements (mm.) —

height	width
13.5	7.8
12.9	7.6

Synonymy —

1961 *Gemmula* (*Kuroshioturris*) *hyugaensis* Shuto, Mem. Fac. Sci. Kyushu Univ. Ser. D, Geol. 11(2), p. 83, pl. 3, figs. 2, 3, 4; text figs. 3, 4.

Records — JAPAN: roadside cutting at Hagenoshita, Miyazaki Prefecture (lower part of Takanabe member, Lowest Pliocene), (type locality).

Ptychosyrinx totomiensis (Makiyama, 1931)

Range — Japan, Kakegawa and Miyazaki groups (Lower Pliocene).

Remarks — This species closely resembles a *Ptychosyrinx timorensis teschi* of optimum sculptural development. The subsutural ridge is strong and sharply projecting, the peripheral nodules are strong and closely spaced and all of the upper basal spirals are strong cords. Except for the relatively large, paucispiral protoconch, without brephic axials, the species would fit into *Ptychosyrinx* typical.

Measurements (mm.) —

height	width	
12.0	6.7	Hagenoshita

Synonymy —

1931 *Turris* (*Gemmula*) *totomicensis* Makiyama, Mem. Coll. Sci. Kyoto Imp. Univ. Ser. B, 7(1), p. 46, pl. 1, figs. 10, 11.

1961 *Gemmula* (*Kuroshioturris*) *totomiensis* Shuto, Mem. Fac. Sci. Kyushu Univ., Ser. D, Geol. 11(2), p. 84, pl. 6, figs. 1, 2, 3, 10; text figs. 3, 4.

Records — JAPAN: roadside cutting at Hagenoshita, Miyazaki Prefecture (lower part of Takanabe member, Lowest Pliocene) (type locality).

Ptychosyrinx asukana (Yokoyama, 1926)

Range — Japan (Pliocene) and Okinawa (Miocene-Pliocene).

Remarks — MacNeil (1960, p. 103) writes of this species: "There seems to be little doubt that the specimen Yokoyama referred to this species in 1928 is a true *Gemmula*. However, doubt has been raised over the identity of the species described under

this name in 1926. Hatai and Nisiyama (1952, p. 198) place it in *Clavatula*. Yokoyama's figure is poor but nevertheless he says in the description that 'the angle is the place where the old sinus band is present, on which the periodic ends of the sinus remain as tubercles.' If this description is accurate it would almost certainly place the shell in the Turriniae and probably in the genus *Gemmula*."

However, MacNeil overlooked that Yokoyama stated in his original description "Whorls about seven of which one and a half are nuclear, smooth and rounded." This rules out the species as a *Gemmula* and also renders inapplicable MacNeil's comparison of the species with my *longwoodensis* (Powell, 1942) from the Duntroonian Upper Oligocene of Southland, New Zealand, not Australia, as stated by him.

Description — Adult shell about 40 mm. (about 1½ inches) in height, slender and rather simple in sculptural characters. Angulate below the middle of whorl height, the periphery not carinated or flanged but studded with round to slightly pointed tubercles. In the Okinawan specimen there is a subsutural fold traversed by 3 weak spiral cords and 3 rather massive plain spirals encircle the upper part of the base, after which the spiral cords become weaker and more closely spaced. The surface, including the peripheral angle and its tubercles, as well as the interstices of the 3 main basal spirals, is crowded with spiral threads.

This species is likely to prove rather closely allied to *nipponica* Shuto, 1961. The measurements for the holotype below are estimated.

Measurements (mm.) —

height	width	
40.0	6.7	holotype
12.5	4.9	Okinawa

Synonymy —

1926 ?*Drillia asukana* Yokoyama, Journ. Tokyo. Imp. Univ. Fac. Sci., Sec. 2, 1(9), p. 331, pl. 38, fig. 18 (not *Pleurotoma asukana* Yokoyama, 1928).

1960 *Gemmula* aff. *asukana* Yokoyama, MacNeil, U. S. Geol. Surv. Prof. Paper 339, p. 103, pl. 5, fig. 12.

Records — JAPAN: Asuka (Satsuka beds, Pliocene) (type locality). OKINAWA: (Yonabaru clay member, Miocene).

Optoturris edita (Powell, 1944)

(Pl. 227)

Range — Balcombian Miocene of Victoria, Australia.

Remarks — Related to *optata* but larger, 25 mm. (1 inch) in height, narrower, with taller spire and longer canal. Sinus and sculpture similar to that of *optata*.

Measurements (mm.) —

height	width	
25.0	6.5	holotype

Synonymy —

1944 *Optoturris editus* Powell, Rec. Auck. Inst. Museum 3(1), p. 12, pl. 7, fig. 3.

Types — The type locality is Grice's Creek, Victoria (Balcombian, Miocene). The holotype is in the Auckland Museum, New Zealand.

Genus Optoturris Powell, 1944

Type: *Pleurotoma optata* Harris, 1897

This is an Australian Miocene genus which is also recorded from the Lower Pliocene of Japan. Protoconch paucispiral of $1\frac{1}{2}$ smooth whorls plus a half whorl of curved axials, the entire protoconch peg-like in shape but with the tip small and asymmetric. The sinus is broadly U-shaped, not very deep and extends over more than half the shoulder, with its lower edge situated at the weak peripheral carina. The genus seems to have no living representatives.

Synonymy —

1944 *Optoturris* Powell, Records Auckland Inst. and Museum 3(1), p. 12. *Type* by original designation: *Pleurotoma optata* Harris, 1897.

Optoturris optata (Harris, 1897)

Range — Janjukian and Balcombian Miocene of Victoria, Australia.

Description — Adult shell 15 to 17 mm. (less than $\frac{3}{4}$ inch) in height, elongate-fusiform, with a tall spire and a moderately long canal. Whorls slightly convex, except for a weak peripheral angulation at about one third of the whorl height. Sculpture of dense thread-like spirals crossed by numerous axial growth lines which thicken at the rest stages, especially in the troughs of the sinus, imparting a rather dense comma-shaped sculptural pattern to the sinus area. Interior of outer lip deeply fluted within.

Measurements (mm.) —

height	width	
16.9	6.0	Balcombe Bay
16.5	6.0	holotype
15.0	5.3	Balcombe Bay

Synonymy —

1897 *Pleurotoma optata* Harris, Cat. Tert. Moll. Brit. Mus. 1, p. 44, pl. 3, figs. 4, a, b.

1944 *Optoturris optatus* Harris, Powell, Rec. Auck. Inst. Mus. 3(1), p. 12.

Types — The type is in the British Museum (Natural History) in London, England.

Records — AUSTRALIA: Hobson's Bay, Victoria, "Eocene" = Balcombian, Miocene (type locality); Muddy Creek, lower beds, Victoria (Balcombian) (Auck. Mus.).

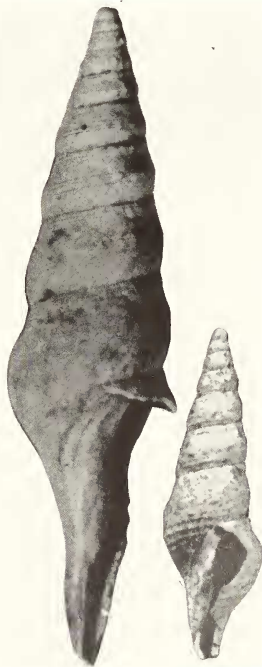


Plate 227. Left fig., *Optoturris edita* Powell, Balcombian Miocene of Grice's Creek, Victoria, Australia (from Powell, 1944, pl. 7, fig. 3). 25 mm. Right fig., *Optoturris kyushuensis* Shuto, Lower Pliocene of Hagenoslita, Japan (from Shuto, 1961, pl. 4, fig. 12).

***Optoturris paracantha* (Tenison-Woods, 1877)**

Range — Janjukian Miocene of Tasmania and Victoria, Australia.

Remarks — Shell larger, broader and of more solid build than the other two Australian species; similarly sculptured but more strongly and with a broad deeply concave sulcus between the suture and the sinus area. Also, the thickened growth-lines, where they cross the sinus area, resolve into a regular gemmate series, reminiscent of *Gemmula*.

Measurements (mm.) —

height	width	
25.6	10.0	Table Cape, Tasmania

Synonymy —

- 1877 *Pleurotoma paracantha* Tenison-Woods, Proc. Roy. Soc. Tasm., for 1876, p. 105.
 1898 *Bathytoma paracantha* T.-Woods, Tate, Proc. Roy. Soc. N.S.W. 31, p. 398.
 1944 *Optoturris paracanthus* T.-Woods, Powell, Rec. Auck. Inst. Mus. 3(1), p. 12

Records — AUSTRALIA: Table Cape, Tasmania (type locality); Torquay, Victoria (Janjukian, Miocene).

***Optoturris kyushuensis* Shuto, 1961**

(Pl. 227)

Range — Takanabe Lower Pliocene of Japan.

Remarks — Shell small, 16.9 mm. (about ½ inch) in height. It appears from the description and figure to be undoubtedly of the above genus, and closely resembles the Australian Balcombian *edita*, from which it is distinguished chiefly by both stronger primary spirals on the base and more definite granules or gemmules on the sinus rib.

Measurements (mm.) —

height	width
16.9	5.1

Synonymy —

- 1961 *Optoturris kyushuensis* Shuto, Mem. Fac. Sci. Kyushu Univ. Ser. D, Geol. 11(2), p. 75, pl. 4, fig. 12.

Records — JAPAN: Hagenoshita, unconsolidated grey fine sandstone (Takanabe member, Lower Pliocene) (type locality).

Genus *Epidirella* Iredale, 1931Type: *Pleurotoma xanthophaes* Watson, 1886

This genus appears to be more nearly allied to *Ptychosyrinx* than to *Gemmula*, but examination of the radula will be necessary to determine its true relationship. In *Gemmula* the radula is of the same type as in *Turris*, that is, a pair of "wishbone-shaped" marginals, whereas in *Ptychosyrinx* Thiele it is with a large unicuspid central tooth in addition to modified "wishbone" marginals but no laterals.

The sinus in *Epidirella* resembles that of *Ptychosyrinx* in being a peripheral, shallow, broadly-open "V," but the sculpture is prominently bicarinate-gemmate; that of *Ptychosyrinx* is gemmate only on the peripheral keel. There is, in addition to the two gemmate keels, a closely spaced pair of subsutural cords and these also are gemmate, the sculptural effect on the spire whorls being an entire covering of gemmules.

The protoconch is tall, with three whorls, the first smooth and narrowly dome-shaped, followed by weak, oblique axials, crossed on the last whorl by an incipient bicarination. Operculum leaf-shaped, with apical nucleus.

The shell is white, covered by a light horny periostracum, and this also is true of *Ptychosyrinx*.

The known distribution of *Epidirella* is the east Australian Continental Shelf, Tasmania and New South Wales, but it is likely that the genus may be found to extend into the Indo-Pacific in deep water. A fossil species, *sayceana* Chapman, 1912, from the Kalimman, Lower Pliocene of Victoria, is tentatively referred to this genus.

Synonymy —

- 1931 *Epidirella* Iredale, Records Australian Mus. 18(4), p. 226. Type by original designation: *Hemipleurotoma tasmanica* May, 1911 = *Pleurotoma xanthophaes* Watson, 1886.

Epidirella xanthophaes (Watson, 1886)

(Pl. 228)

Range — Southeast Australia and Tasmania.

Remarks — Hedley (1922, p. 231) referred this species to his genus *Epidira* and cited *Hemipleurotoma tasmanica* May, 1911, as a synonym. Iredale (1931, p. 225) could not reconcile May's species with Watson's description and figure of *xanthophaes*, and in erecting a new genus, *Epidirella*,

cited *tasmanica* as type. Laseron (1954, p. 7), obviously unaware of Iredale's genus, provided another new genus, *Austrogemmula*, for May's species and at the same time remarked that Watson's species has never been recognized since its first recording.

A photograph of the type of *xanthophaes* Watson, here reproduced, shows the sculpture to be stronger and more noticeably gemmate than it appears in Watson's figure, but not so pronounced as in most examples attributed to *tasmanica* that the writer has seen. Nevertheless, the strength of the sculpture seems to be rather variable, and so upon the available material separation from Watson's species appears unwarranted.

Measurements (mm.) —

height	width	
26.5	9.5	Twofold Bay
25.0	—	Crookhaven (Laseron)
24.0	8.4	holotype of <i>xanthophaes</i>
20.0	7.0	Disaster Bay

Synonymy —

- 1886 *Pleurotoma xanthophaes* Watson, Challenger Zool. 15, p. 282, pl. 26, fig. 1.
 1911 *Hemipleurotoma tasmanica* May, Proc. Roy. Soc. Tasm., 1910, p. 391, pl. 13, fig. 16.
 1922 *Epidira xanthophaes* Watson, Hedley, Rec. Aust. Mus. 13(6), p. 231.
 1931 *Epidirella tasmanica* May, Iredale, Rec. Aust. Mus. 18(4), p. 226.
 1954 *Austrogemmula tasmanica* May, Laseron, N.S.W. Turridae, Handb. Roy. Zool. Soc. N.S.W., p. 7, pl. 1, figs. 8, 9.



Plate 228. *Epidirella xanthophaes* (Watson). Holotype, 30-35 fms., off Port Jackson, New South Wales, Australia. 24.0 mm.

Types — The holotype of Watson's *xanthophaes* is in the British Museum (Natural History), London.

Records — NEW SOUTH WALES: 30-35 fms., off Port Jackson (type locality for *xanthophaes*); Disaster Bay, 5 fms.; off Crookhaven, 30-35 fms. (Laseron, 1954); off Cape Everard, 70-80 fms. (Aust. Mus.); off Twofold Bay, 5-8 fms. (T. Gerrard). TASMANIA: off Schouten Id., 40 fms. (type locality for *tasmanica*). VICTORIA: Lakes Entrance, 20 fms. (Macpherson & Gabriel).

Epidirella sayceana (Chapman, 1912)

Range — Lower Pliocene of Victoria, Australia.

Synonymy —

1912 *Pleurotoma sayceana* Chapman, Proc. Roy. Soc. Vict. 25(n.s.), p. 191, pl. 12, fig. 7.

1944 ?*Epidirella sayceana* Chapman, Powell, Rec. Auck. Inst. Mus. 3(1), p. 16.

Records — VICTORIA: Lakes Entrance (type locality); Jemmy's Point (Kahiman, Lower Pliocene).

Genus *Epidironea* Iredale, 1931

Type: *Epidironea hedleyi* Iredale, 1931

The genus *Epidironea*, despite its resemblance to the Clavinae, belongs in the Turridae as shown both by the peripheral location of the sinus and by the radula which is a modified "wishbone" type. These shells have a tall acuminate spire but a truncated body whorl; the anterior canal is not produced but ends in a broad shallow notch at the termination of a well-marked fasciole. The anal sinus is a moderately deep, narrowly rounded "U," situated at the periphery. The protoconch is small and of two smooth turbinate whorls. The post-nuclear sculpture is typically of fine spiral cords and threads, crossed obliquely by weak axials which are strengthened into elongate, laterally-compressed nodes over both the subsutural fold and the peripheral carina. The outer lip is thin, without a varix, and there is no parietal tubercle. Interior of aperture spirally fluted. For radula, see pl. 229.

The Recent geographical range of the genus is mostly southern Australia to Tasmania and New South Wales but there is evidence that it occurs much farther afield as instanced by E. A. Smith's *multiseriata* which has been recorded from Ceylon, Persian Gulf and China Seas.

Four Tertiary species are known from southern Australian horizons, extending from the Janjukian Miocene to the Adelaidean Lower mid-Pliocene.

The type species of this genus, a well-known New South Wales shell, has been the subject of much confusion both at the generic and the specific level. When Hedley (1918, p. M79) proposed *Epidira* he cited *Clavatula striata* Gray, 1827, as type, but later (1922, p. 230, pl. 43, figs. 18-20) showed that he had in mind the New South Wales shell previously known as either *striata* Gray (but not Gray of 1827) or *owenii* Reeve, 1843.

Iredale (1931, p. 225) rejected *Epidira* in connection with the *striata* of Hedley, stating that Gray's description did not fit the New South Wales shell and that Gray's species, at present indeterminate, probably came from Western Australia.

Watson (1886, p. 312) used *Pleurotoma owenii* (Gray ms.) Reeve, 1843, for the New South Wales shell, citing *Clavatula striata* Gray as a synonym, but Reeve's species was stated to be from the East Coast of Africa. The specimen used by Reeve to

illustrate his *owenii* certainly resembles the New South Wales shell but he based the name upon a specimen in Gray's cabinet and remarked that it "is of unusually large size, at least one-third longer than that selected for illustration."

The types of both *striata* and *owenii* seem to be lost and this induced Iredale to clarify the situation by providing a new genus and species name for the New South Wales shell.

Synonymy —

1931 *Epidironea* Iredale, Records Australian Mus. 18(4), p. 225. Type by original designation: *Epidironea hedleyi* Iredale, 1931.

A full treatment of *Epidironea* is planned for a future paper, and for the present I am considering in detail only the sole, strictly Indo-Pacific species, *multiseriata* (E. A. Smith, 1877). The others, mainly from southeast Australia, are listed here alphabetically by species, but in their original generic combinations.

Epidironea multiseriata (E. A. Smith, 1877)

(Pl. 230, fig. 3)

Range — Persian Gulf to the South China Sea.

Remarks — This species closely resembles the type of *Epidironea* in most essentials; the sculpture is much stronger but of similar style, the form of the sinus, anterior canal features, thin outer lip, presence of fluting within the aperture and lack of a parietal tubercle all match very closely. The only deviation from typical *Epidironea* is in the protoconch which is carinate on whorls two and three.

Description — Adult shell, 15 to 19 mm. ($\frac{1}{2}$ to $\frac{3}{4}$ inches) in height, solid, drilliaform, with tall acuminate spire but truncated body whorl. Whorls eight, plus a small depressed-turbinate protoconch of three whorls, the first whorl smooth, the second carinated below the middle and the third crossed by regular arcuate axials in addition to the carina. Sculpture strong, consisting of spiral gemmate cords crossed by weaker axials. On the spire there are two massive gemmate folds, one subsutural and the other forming the sinus ridge; both are com-

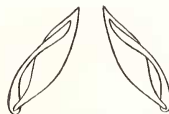


Plate 229. Radula of *Epidironea hedleyi* Iredale. From specimen from ANSP, Port Jackson, New South Wales, Australia (courtesy of V. Orr).

posed of two fused cords. The gemmules also are fused to form tall, narrowly rectangular nodes, the subsutural series slightly retractive and the sinus series slightly protractive; they number about twenty per whorl. Between the two folds is a deep sulcus bearing one or two spiral threads. On the base below the periphery there are eight strong spiral gemmate cords and a further series of six plain spiral cords on the anterior end.

The body whorl is truncated and has a very short anterior canal with a wide shallow notch at the termination of a well-defined fasciole. Outer lip thin, fluted within. Sinus moderately deep, narrowly U-shaped, occupying the upper portion of the broad peripheral carina. Colour dull creamy white.

Measurements (mm.) —

height	width	
19.0	7.0	Mekran Coast (Brit. Mus.)
15.0	5.0	Ceylon (holotype)
14.2	5.6	Singapore

Synonymy —

1877 *Pleurotoma multiseriata* E. A. Smith, Ann. Mag. Nat. Hist. (ser. 4) 19, p. 491.

1917 *Turris (Gemmula) multiseriata* E. A. Smith, Melvill, Proc. Malac. Soc. 12, p. 145, pl. 8, fig. 3.

Types — The type locality is Ceylon. The holotype is in the British Museum (Natural History), London.

Records — CEYLON: (type locality); INDIA: Madras (Winckworth coll., Brit. Mus.); PERSIAN GULF: Mekran Coast (Townsend coll., Brit. Mus.); MALAYA: Johore Strait (Winckworth coll., Brit. Mus.); Singapore (Powell coll.). THAILAND: 4 mi. E. of Phuket Harbour, 80 ft. (R. Tucker Abbott, 1963).

List of Recent *Epidirone* species

beachportensis (Cotton & Godfrey, 1938), *Epidirone*, Rec. S. Aust. Mus. 6(2), p. 205, pl. 17, fig. 4 (150 fms. off Beachport, South Australia).

candida Laseron, 1954, *Epidirone*, N.S.W. Turridae, Handb. Roy. Zool. Soc. N.S.W., p. 10, pl. 2, fig. 30 (70-80 fms. off Cape Everard, N.S.W., Australia). See pl. 230, fig. 9.

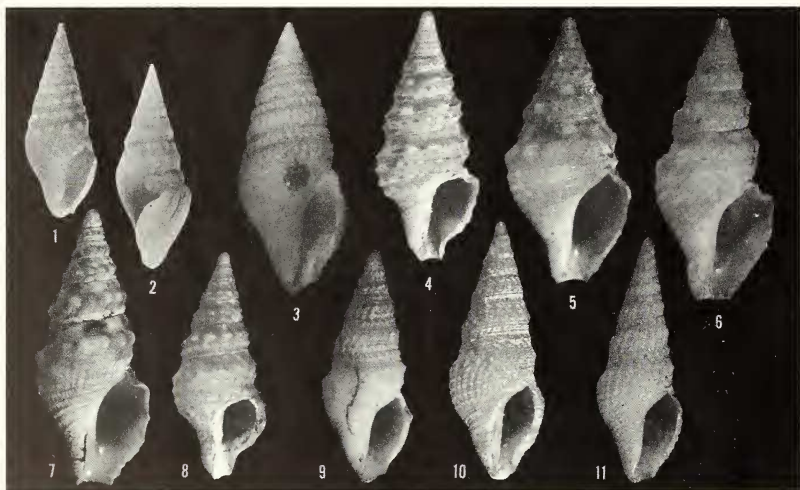


Plate 230

- Figs. 1, 2 *Epidirone hedleyi* Iredale, Port Jackson, New South Wales, Australia, 27 mm.
 3 *Epidirone multiseriata* (E. A. Smith), Holotype, Ceylon. 15 mm. Type in Brit. Mus. (Nat. Hist.)
 4 *Epidirone carinata* Laseron, Holotype, 40-50 fms., off New South Wales, Australia, 17 mm.
 5 *Epidirone nodulosa* Laseron, Holotype, 50 fms., off New South Wales, Australia, 19.5 mm.
 6 *Epidirone gabensis* (Hedley), Holotype, 80 fms., off Cabo Id., Victoria, Australia.

- 7 *Epidirone torquata* (Hedley), Holotype, Port Arthur, Tasmania.
 8 *Epidirone molleri* Laseron, Holotype, 50 fms., off New South Wales, Australia, 16 mm.
 9 *Epidirone candida* Laseron, Holotype, 70-80 fms., off New South Wales, Australia, 15 mm.
 10 *Epidirone tuberculata* Laseron, Holotype, 40-50 fms., off New South Wales, Australia, 15.5 mm.
 11 *Epidirone costifera* Laseron, Holotype, 40-50 fms., off New South Wales, Australia, 16 mm.
 (all types except fig. 3 in the Australian Museum, Sydney)

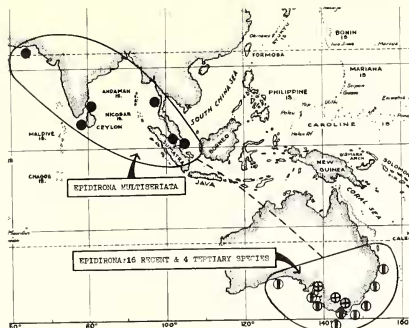


Plate 231. Geographical distribution of *Epidirone multiseriata* (E. A. Smith) and 16 Recent and 4 Tertiary Australian species.

- carinata* Laseron, 1954, *Epidirone*, N.S.W. Turridae, Handb. Roy. Zool. Soc. N.S.W., p. 9, pl. 2, figs. 24-26 (40-50 fms. off Manning R., N.S.W., Australia). See pl. 230, fig. 4.
- costifera* Laseron, 1954, *Epidirone*, N.S.W. Turridae, Handb. Roy. Zool. Soc. N.S.W., p. 10, pl. 2, fig. 29 (40-50 fms. off Manning R., N.S.W., Australia). See pl. 230, fig. 11.
- findersi* (Cotton & Godfrey, 1938), *Epideira*, Rec. S. Aust. Mus. 6(2), p. 205, pl. 17, fig. 1 (80 mi. west of Eucla, 75 fms., South Australia).
- gabensis* (Hedley, 1922) *Epideira*, Records Australian Mus. 13(6), p. 228, pl. 53, fig. 16 (80 fms., Gabo Id., Victoria, Australia). See pl. 230, fig. 6.
- hedleyi* Iredale, 1931, *Epidirone*, Records Australian Mus. 18(4), p. 225 (Port Jackson, New South Wales). See pl. 230, figs. 1, 2.
- jaffaensis* (Verco, 1909), *Drillia*, Trans. Roy. Soc. South Australia 33, p. 298, pl. 26, figs. 7-9 (130 fms. off Cape Jaffa, South Australia).
- molleri* Laseron, 1954, *Epidirone*, N.S.W. Turridae, Handb. Roy. Zool. Soc. N.S.W., p. 11, pl. 2, figs. 31, 32 (50 fms. off Crowdy Head, N.S.W., Australia). See pl. 230, fig. 8.
- monile* (Kiener, 1839-40), *Pleurotoma*, Coq. Viv. Pleurot. 5, p. 52, pl. 15, fig. 3 (non Brocchi, 1814; see *quoyi* Desmoulins, 1842).
- nodulosa* Laseron, 1954, *Epidirone*, N.S.W. Turridae, Handb. Roy. Zool. Soc. N.S.W., p. 9, pl. 1, figs. 21-23 (50 fms. off Crowdy Head, N.S.W., Australia). See pl. 230, fig. 5.

- perksi* (Verco, 1896), *Surcula*, Trans. Roy. Soc. South Australia 20, p. 224, pl. 7, fig. 3, a-c (15 fms. off Thistle Id., South Australia).
- philipineri* (Tenison-Woods, 1877), *Pleurotoma*, Proc. Roy. Soc. Tasmania, p. 136 (N.W. coast of Tasmania).
- quoyi* (Desmoulins, 1842), *Pleurotoma*, Actes Soc. Linn. Bordeaux 12, p. 167, nom. nov. for *Pl. monile* Kiener, 1839-40 (non *Pl. monile* Brocchi, 1814). (Western Port, Victoria).
- schoutanica* (May, 1911), *Drillia*, Proc. Roy. Soc. Tasmania (1910), p. 391, pl. 14, fig. 17 (80 fms., off Schouten Id., Tasmania).
- striata* Gray, Hedley, 1922, *Epideira*, (not of Gray, 1827), Records Australian Mus. 13(6), p. 230, pl. 43, fig. 18-20 (is now *hedleyi* Iredale, 1931) (New South Wales).
- torquata* (Hedley, 1922), *Epideira*, Records Australian Mus. 13(6), p. 230, pl. 43, fig. 21 (Port Arthur, Tasmania). See pl. 230, fig. 7.
- tuberculata* Laseron, 1954, *Epidirone*, N.S.W. Turridae, Handb. Roy. Zool. Soc. N.S.W., p. 10, pl. 2, figs. 27, 28 (30-35 fms., off Port Stephens, New South Wales, Australia). See pl. 230, fig. 10.

List of fossil *Epidirone* species

- adelaidensis* (Ludbrook, 1941), *Bathytoma*, Trans. Roy. Soc. South Australia 65(1), p. 97, pl. 5, fig. 17 (Abattoirs Bore, 400-500 ft., Adelaide, South Australia; Pliocene).
- laevis* Pritchard, 1904, var. of *Pleurotoma schwyni*, Proc. Roy. Soc. Victoria 17, p. 328 (non *laevis* Bell, 1890; see *suppressa* Finlay, 1927).
- powelli* Ludbrook, 1957, *Epidirone*, Trans. Roy. Soc. South Australia 81, p. 86, pl. 5, fig. 3 (Weymouth's Bore, 310-530 ft., Adelaide, South Australia; Lower mid-Pliocene).
- suppressa* (Finlay, 1927), var. of *Epideira schwyni*, Trans. N.Z. Inst. 57, p. 516, nom. nov. for *laevis* Pritchard, 1904 (non Bell, 1890) (Victoria, Australia; Miocene).
- cardoni* (Tate, 1899), *Surcula*, Trans. Roy. Soc. South Australia 23, p. 108, pl. 1, fig. 3, a-b (Murray Desert, Victoria, Australia (Janjuka?); Miocene).

[These occasional blank areas occur between genera and subgenera to permit the insertion of new material and future sections in their proper systematic sequence.]

Genus *Lophiotoma* Casey, 1904

Type: *Pleurotoma acuta* Perry, 1811.

This is a well-known group of Indo-Pacific turrids closely resembling *Turris* but with the sinus always on the peripheral keel, not on a subsidiary ridge above the periphery, as in true *Turris*. For shells identical with *Lophiotoma* in adult features, but with a blunt paucispiral protoconch, see the subgenus *Lophioturris*, following.

The counterparts of this genus in the tropical Eastern Pacific, the Caribbean and the Tertiary of the South Eastern United States are the genera *Pleurohira* and *Polystira*, the former Eocene and Oligocene and the latter Miocene to Recent. A more shallow and broadly V-shaped sinus, and protoconch differences, separate these two from *Lophiotoma*, but there was probably a common ancestry.

Protoconch light reddish brown, tall, polygyrate, narrowly conical of $3\frac{1}{2}$ to 4 whorls, strongly sculptured with numerous crisp flexuous axials over the last $2\frac{1}{2}$ whorls, crossed by numerous faint spiral threads, which are visible only on the axials, not in the interstices. The first $1\frac{1}{2}$ whorls are smooth, probably due to erosion, for no very well preserved apices were found. A non-eroded protoconch is probably axially costate throughout, as in *Xenroturris*. The weak nodulation or undulation of the peripheral sinus rib on the first post-embryonic whorl, shown in the figure, does not persist over subsequent whorls, nor is it a common feature in other material examined. The protoconch figure is from a Persian Gulf specimen.

Synonymy —

- 1904 *Lophiotoma* Casey, Trans. Academy Sci. St. Louis 14(5), p. 130.
1928 *Lophiotoma* Casey, Woodring, Publ. no. 385, Carnegie Inst. Washington, pt. 2, p. 146. Type by subsequent designation: *Pleurotoma tigrina* Lamarck, = *acuta* Perry, 1811.



Plate 232. Nuclear whorls of *Lophiotoma* s.s. and the subgenus *Lophioturris*. Left fig., *Lophiotoma* (*Lophiotoma*) *acuta* (Perry) from the Persian Gulf. Right fig., *Lophiotoma* (*Lophioturris*) *indica* (Röding) from Yeppoon, Queensland, Australia.

Lophiotoma acuta (Perry, 1811)

(Color pl. 180; pl. 233; pl. 234)

Range — Recent: Red Sea and East Africa to Japan and Melanesia. Fossil: Pliocene and Pleistocene of Indonesia.

Remarks — This species, better known as *tigrina* Lamarck, is the most widespread of the turrids. It is also most variable in shape, sculpture and in colour pattern. The more stable of these variants conform vaguely to geographic patterns over marginal areas but in no hard and fast manner, for not only do forms integrate and coalesce at the crossroads between the Indian and Pacific Oceans but odd forms are likely to crop up in an otherwise constant assemblage for an area.

This is true of *jickelii* Weinkauff, the type locality for which is the Red Sea. The *jickelii* form tends to coarser sculpture than in *acuta* typical, the trend being a reduction in strength of the peripheral carina and increased prominence of the primary cords. See pl. 180, figs. 14, 19.

The writer has seen only two Red Sea examples so is not competent to state what the overall characteristics of the Red Sea populations may be. The few Persian Gulf specimens examined show slight carinal reduction but are nevertheless nearer to typical *acuta*. Forms resembling *jickelii* were noted also from Zanzibar, Philippines and Buchan's Point, Cairns, Queensland, but in all cases either in asso-

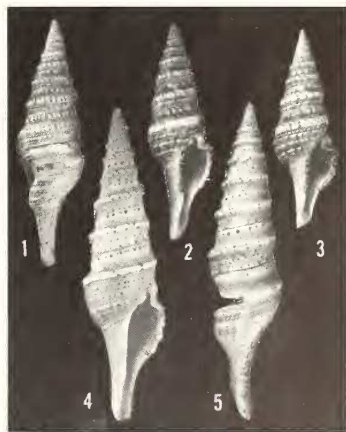


Plate 233. Figs. 1-3, *Lophiotoma acuta* (Perry) form *jickelii* (Weinkauff). Cebu Id., Philippines. Figs. 4, 5, *Lophiotoma acuta* (Perry). Cotype of *L. microsticta* Casey, 1904. Cebu Id., Philippines (U.S. Nat. Mus.).

ciation with or in close proximity to a population of typical *acuta*.

If the Red Sea populations should prove to be predominantly *jickelii* type then there may be a case for considering that population a geographical subspecies which tends to infiltrate eastward to Zanzibar, the South China Sea and north Queensland, but the evidence at present is against such an assumption.

What little is known of the ecological conditions under which the respective forms live shows this factor to be of importance both in respect to the proportions of the shell and the coloration. The elongated, pale, sparsely-spotted form, *microsticta* Casey from the Philippines, for instance, is the common and apparently exclusive form in the Marshall Islands where it occurs in shallow water on white coral sand. Similar shells range northward to Japan.

A narrow but profusely-maculated form is found in East Indies waters and these closely resemble Lamarck's *Encyclopédie méthodique* figure (pl. 439, fig. 6) of his *marmorata* (non *marmorata* Lamarck, 1822). It is significant that shells of this form from Koeroedoi Island, Dutch New Guinea, were found living on black sand and silt.

A broad heavily-maculated shell is the common form at Zanzibar, East Africa and Madagascar, and this form spreads across the Indian Ocean and infiltrates strongly throughout the East Indies, the Philippines and Queensland.

Sowerby's *Pleurotoma notata* from Hong Kong resembles the *jickelii* form of *acuta*, but in this case suppression of the peripheral carina is due to shell injury at the commencement of the antepenultimate whorl. See pl. 234.

Another synonym of *acuta* is Weinkauff's *picturata* which fits the pale, sparsely patterned shells with a relatively short canal, found on sand in many shallow-water locations along the north Queensland coast. These are nearest to *acuta* typical, but the broad heavily maculated form of *acuta*, the narrow heavily maculated form (*maculata*) and the coarsely sculptured *jickelii* form also occur along the Queensland coast and on the offshore islands. All occur in sandy locations, but the *maculata* form seems to favour deeper water on a shelly bottom.

In Fiji, the typical, the *maculata* and the *picturata* forms all occur. Specimens, with field notes, from the collection of Mr. W. Jennings show that the typical form occurs in sand at 2 or 3 feet below low water, the *picturata* form from 4 or 5 fathoms

and the *maculata* form from 4 or 5 feet below low tide off the edge of coral reefs.

Still another probable synonym of *acuta* is Dunker's *Pleurotoma peaseana*, the type of which is supposed to be in the Godeffroy Museum, Hamburg. It was referred to the synonymy of *marmorata* (= *acuta*) by Hedley (1922, p. 216).

Specimens which approach nearest to Perry's figure in proportions, sculptural detail and coloration come from the islands of the tropical Southwest Pacific. Typical *acuta* is a relatively broad shell, strongly carinate and with a sparse pattern of small brown dots on a pale ground.

Description of Typical Form—Adult shell 45 to 50 mm. (1½ to 2 inches) in height, of light build, fusiform, with a tall spire, 27° to 34°, and with a long rather straight canal. Spire slightly taller than the height of the aperture plus canal. Whorls 10 or 11, plus a tall narrowly-conic protoconch of 3½ to 4 whorls, of yellowish brown colour and strongly sculptured with closely spaced, slightly oblique and arcuate axials which are crossed at right angles by faint spiral threads. Spire whorls dominated by the centrally placed sinus carina, consisting of an upper and a lower sharp-edged keel with a smooth concavity between. The upper keel projects slightly more than the lower one. The primary cords consist of a strong subsutural one, and three below the carina, the second one emergent at the suture and the third below the level of the top of the aperture. The secondary sculpture forms a dense surface-cover of spiral threads of varying strength, 8 to 10 in number on the shoulder from between the subsutural cord and the sinus rib. Ground colour, creamy-white, sparsely speckled with small, dark-brown, rectangular spots, most prominent on the subsutural cord, both edges of the sinus rib and on the three primary cords below it. Most of the secondary spirals are minutely speckled.

Measurements (mm.)—

(a) Typical sparsely speckled form

height	width	spire angle	
50.0	16.0	32°	Fiji
46.0	15.5	34°	Fiji
44.0	13.0	28°	Low Isles, Queensland
43.5	14.0	33°	Fiji
30.0	11.0	32°	Samoa
Spire angle 28° to 34° = average 31.8°			

(b) Narrow, sparsely maculated form (*microsticta*)

height	width	spire angle	
59.7	14.6	23°	Cebu, cotype of <i>microsticta</i>
51.4	13.0	25°	Kii, Japan
48.7	13.5	25°	Ryukyu Ids.
44.0	12.3	25°	Palau Ids.
Spire angle 23° to 25° = average 24.5°			

- (c) Broad, heavily maculated form (*tigrina* Lamarck)
- | | | | |
|------|------|-----|----------------------------|
| 66.5 | 17.0 | 28° | Chwaka, Zanzibar |
| 65.0 | 18.0 | 30° | Kiwengwa, Zanzibar |
| 60.0 | 16.7 | 30° | Mozambique |
| 58.0 | 17.7 | 29° | Mozambique |
| 57.5 | 16.0 | 29° | Ko Phuket, W. Thailand |
| 53.0 | 16.0 | 30° | Mozambique |
| 43.5 | 13.2 | 28° | Low Isles, Queensland |
| 41.5 | 13.0 | 30° | King's Reef, N. Queensland |
| 39.5 | 12.0 | 27° | Tutuila, Samoa |
- Spire angle 27° to 30° = average 29.1°
- (d) Narrow, heavily maculated form (*marmorata* Lamarck, 1816)
- | | | | |
|------|------|-----|--------------------------------|
| 48.0 | 13.0 | 28° | all Kaipoori, Dutch New Guinea |
| 46.2 | 12.5 | 27° | |
| 42.5 | 11.0 | 26° | |
| 30.1 | 7.7 | 24° | |
| 25.2 | 7.0 | 26° | |
- Spire angle 24° to 28° = average 26.2°

Description of jickelii form — The *jickelii* form is a narrow shell with the sinus rib formed of two closely spaced, rounded cords and with the secondary sculpture quite strongly developed. The sinus rib is not strongly projecting as in the typical species and the upper margining cord does not project farther than the lower one. The colour pattern is in the form of numerous dark, reddish brown, rectangular patches and spots roughly connected longitudinally with wavy lines, reminiscent of the *crispus* pattern. Adult shell 42 to 47 mm. (about 1½ to 2 inches) in height, fusiform, with a tall spire, 22° to 25°, and a long canal. Spire approximately equal to the height of the aperture plus canal. Spire whorls weakly carinated medially by the sinus ridge which is bordered below by a rounded cord. Subsutural fold well-developed as a broad collar, almost as strong as the sinus rib. The whole surface covered by strong, rounded, spiral cords and crisp threads. Whorls 11 or more.

Measurements (mm.) —

height	width	spire angle	
53.0	13.0	—	(Weinkauff)
49.0	14.0	25°	
47.0	13.7	22°	
41.7	11.6	24°	

Synonymy —

- 1811 *Pleurotoma acuta* Perry, Conchology, London, pl. 54, fig. 5 (no locality).
 1816 *Pleurotoma marmorata* Lamarck, Tableau Encyclopédique et Méthodique, Paris, pl. 439, fig. 6, Le Liste, p. 8.
 1822 *Pleurotoma tigrina* Lamarck, Hist. Nat. Anim. sans Vert. 7, p. 95.
 1829 *Pleurotoma punctata* Schubert & Wagner, Suppl. Conch. Cab. 12, p. 155, pl. 234, figs. 4103, a, b (no locality).

- 1839–40 *Pleurotoma tigrina* Lamarck, Kiener, Coquilles Vivantes 5, p. 10, pl. 8, fig. 1 (Indian Ocean and Madagascar).
 1843 *Pleurotoma tigrina* Lamarck, Deshayes, Anim. sans Vert. 9, p. 352, sp. 20 (no locality).
 1843 *Pleurotoma tigrina* Lamarck, Reeve, Conch. Iconica 1, pl. 1, fig. 3 (Philippines, sandy mud).
 1871 *Pleurotoma (Turris) peaseana* Dunker, Malak. Blatt. 18, p. 154.
 1875 *Pleurotoma jickelii* Weinkauff, Conch. Cab. 4(3), p. 20, pl. 4, figs. 2, 3.
 1876 *Pleurotoma peaseana* Dunker, Weinkauff, Conch. Cab. 4(3), p. 69, pl. 15, figs. 1–3.
 1876 *Pleurotoma picturata* Weinkauff, Conch. Cab. 4(3), p. 66, pl. 2, fig. 10.
 1884 *Pleurotoma tigrina* Lamarck, Tryon, Manual of Conch. 6, p. 164, pl. 2, fig. 10.
 1888 *Pleurotoma notata* Sowerby, Proc. Zool. Soc., p. 566, pl. 28, fig. 17.
 1904 *Lophiotoma microsticta* Casey, Trans. Acad. Sci. St. Louis 14, p. 130 (not figured; Cebu, Philippines).
 1915 *Pleurotoma* (s.str.) *tigrina* Lamarck, Tesch, Palaeontologie von Timor 9, Stuttgart, p. 24, pl. 76(4), fig. 36 (Pliocene, Timor).
 1931 *Pleurotoma tigrina* Lamarck, van der Vlerk, Leidsche Geol. Meded. Rijksmus. Geol. Min. Leiden 5, p. 219 (Sumatra, Java, Timor and Celebes. Miocene, Pliocene and Pleistocene records).
 1956 *Lophiotoma tigrina* Lamarck, Kaicher, Indo-Pacific Sea Shells, section 5, Toxoglossa, pl. 1, fig. 5.
 1961 *Turris tigrina* Lamarck, Habe, Shells of Japan 2, pl. 38, fig. 18 (microsticta form).
 1961 *Turris notata* Sowerby, Habe, Shells of Japan 2, pl. 38, fig. 16.

Types — The type of *notata* is in the British Museum (Natural History); it measures 55 × 16 mm.



Plate 234. *Lophiotoma acuta* (Perry). Holotype of *Pleurotoma notata* Sowerby, 1888. Hong Kong.

Records — RED SEA: Massaua (type of *jickelii*) (Calvert coll., MCZ). PERSIAN GULF: (Brit. Mus.), ANDAMAN ISLANDS: Port Blair (Winckworth coll., Brit. Mus.). SEYCHELLES: N.W. Bay, Mahé (Winckworth coll., Brit. Mus.). CEYLON: (USNM). ZANZIBAR: Chwaka, 0.4 ft.; 1½ mi. W.S.W. Ras Mungwe, 8 fms.; 1 mi. W.N.W. Ras Mbweni, 7 fms.; S. side of Pwakuu Id., 11-18 fms.; between Mwamba, Ukombi and Chumbe Ids., 4-6 fms.; Kizimkazi, 0-3 ft.; Kiwengwa, 0-3 ft. (ANSP). MADAGASCAR: 9-12 ft., Pte. du Cratère, S.W. Nossi Bé; 9 fms., 3 mi. N.N.E. of Nossi Fali, E. of Nossi Bé (ANSP). MAURITIUS: (USNM). PORTUGUESE EAST AFRICA: Mozambique City (ANSP). NORTH BORNEO: shore at Kudat (Mrs. M. Saul, ANSP). MALAYA: Singapore (ANSP). THAILAND: 4 mi. E. of Phuket Harbour, 80 ft. (R. Tucker Abbott). DUTCH NEW GUINEA: 3 ft., black sand and silt, ¼ mi. S. of Kaiporei Village, Koeroedoi Id. (nearest to Lamarck's 1816 *marmorata*); N.E. Ambai Id., Japan Id., 5 ft., old reef; 2 mi. N.W. Rani Id., Schouten Ids., 4-40 ft.; island off N.E. tip of Ambai, Japan Id., 10-15 ft.; 1.3 mi. S.W. of Cape Mantoeoeri, Koeroedoi Id., 4 fms.; ½-1 mi. E. of Mios Woendi Id., 3-30 ft. (ANSP); near Hollandia (USNM). HONG KONG: (type of *notata*). JAPAN: Oshima Osumi (USNM); Kii (ANSP) (A. W. B. Powell coll.). RYUKYU ISLANDS: Okama Bay; Nago; Taketomi Id. (D. Thaanum coll.). PHILIPPINES: Island of Cebu (cotype of *microsticta*); Port Binang, Subic Bay (USNM); Tabaco, Albay Province, Luzon; Zamboanga, Mindanao Id.; 12-24 ft., E. side Jagoliao Id., N.W. end of Bohol Id.; Calatagan, Batangas, Luzon Id. (ANSP); Davao, Mindanao Id. (A. W. B. Powell coll.). PALAU ISLANDS: S.E. corner of Eil Malk, Kayangel Lagoon, 5-15 ft.; E. of Ferry Dock, Peleliu, dredged; N. of entrance to Karamando Bay, West Babelthup; 3 mi. N.E. of Eil Malk, E. of Yoo Passage, Malakal Harbour, dredged; E. lagoon off Melekeik, East Babelthup Id.; 1 mi. S. of West Passage, Babelthup Id.; Kossol Passage, west entrance, 20 fms. (all ANSP). MARSHALL ISLANDS: Taka Id., Taka Atoll; Bikini Id., N.E. shore; E. side Enver Id., Bikini; 2 mi. W. of Busch, 20 fms.; 2 mi. N. of Ime, Arno Atoll; 1-2 mi. N. of Jiyab Lagoon, Arno Atoll (USNM) (all *microsticta* form). NEW HEBRIDES: (Australian Mus.). SOLOMON ISLANDS: Ugi Id., (USNM). NEW CALEDONIA: 4-10 ft., barrier reef, Touho Bay (ANSP). AUSTRALIA: Queensland: Challenger Bay, Palm Id. (ANSP); Dunk Id.; King's Reef (A. W. B. Powell coll.); Hope Id., 5-10 fms.; Lizard Id.; Murray Id.; Palm Id.; Mast Head Ids.; Rocky Ids.; Cape Flattery; Crescent Reef (Australian Mus.); Moreton Bay (Mrs. J. Kerslake). FIJI: Beqa Id.; Vatulele Id. (D. Thaanum coll.); Yasawas Id. (USNM); Akulau Id., 2-5 ft.; Wading Id.; Namotu Id., 4-5 fms. (W. Jennings). SAMOA: Toala. N.W. Upolu Id., 10 ft., sand, lagoon off Mulifanua, Upolu Id.; Tutuila (ANSP).

Fossil Records — Pliocene, West Sumatra; Pliocene, Sonde beds, Java; Timor. Pleistocene, Celebes (van der Vlerk, 1931, p. 219).

Lophiotoma albina (Lamarck, 1822)

(Color pl. 180, figs. 11, 12; pl. 235)

Range — Madagascar to the Carolines, Micronesia.

Remarks — Although closely allied to *acuta* this species is remarkably constant. The chief distinguishing points are the triple-corded sinus rib, relatively weak spiral sculpture, strong overlay of dense axial folds, a very distinctive pattern consisting of an overall sprinkling of minute brown dots, and a peripheral row of regularly spaced dark-brown rectangular markings, each of which

is in the form of three horizontal lines defining each of the three sinus cords. The general appearance of the shell is white with a revolving row of peripheral maculations. Whorls 10, plus the protoconch, a remnant of which remains in one specimen, suffice to show that it is of a similar multi-spiral form as that of *acuta*. Adult size 37 to 41.5 mm. (about 1½ inches) in height. Spire about three-fourths the height of the aperture plus canal, angle 23° to 25°. Whorls only slightly angled by the peripheral carina.

Measurements (mm.) —

height	width	spire angle	
74.0	—	—	Balabac, Philippines
57.0	14.5	—	Andaman Ids.
41.5	11.2	23°	Moluccas
37.0	11.0	25°	Moluccas

Synonymy —

1822 *Pleurotoma albina* Lamarck, Anim. sans Vert. 7, p. 96. (no locality).

1843 *Pleurotoma albina* Lamarck, Reeve, Conch. Iconica 1, pl. 9, fig. 77.

Records — MADAGASCAR: Mayotte, 50 metres, coarse sand in lagoon (ANSP). ANDAMAN ISLANDS: (Tomlin coll., Nat. Mus. Wales). MOLUCCAS: (Casey coll., USNM), Java: (Tomlin coll.). Caroline Islands: Yap (C. Kile, 1960, ANSP). PHILIPPINES: Balabac, Palawan Id. (coll. A. D'Attilio, New York); Lubang Id. (Tomlin coll.).

Lophiotoma albinoides (Martin, 1883)

(Pl. 246, figs. 1, 2)

Range — Java, Tji Longan, near Selatjan, Njalindoeng beds, Lower Miocene.

Remarks — This species appears to be quite distinct judging from the illustrations which also show an enlargement of the sculptural detail. The shell is slender like the Recent *albina*, but the

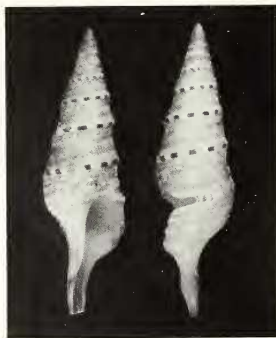


Plate 235. *Lophiotoma albina* (Lamarck). Molucca Islands. 41 mm.

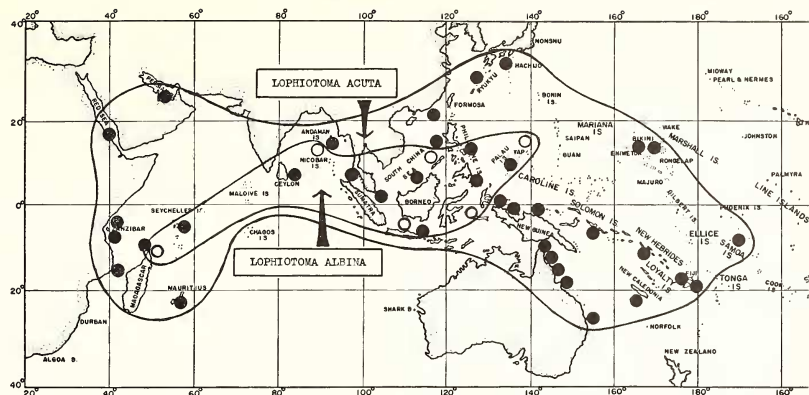


Plate 236. Geographical distribution of *Lophiotoma (Lophiotoma) acuta* (Perry) in solid dots and *L. (L.) albina* (Lamarck) in open circles.

whorls are not rendered so angulate by the spiral keels. Also, it would appear from the figures that the sinus rib is above the middle and consists of two closely spaced, beaded spirals with a heavier smooth one below. The subsutural spirals are weak. It is more likely, however, that the smooth peripheral carina will prove to be coincident with the sinus, the shape and nature of which is not apparent in the illustrations.

Until the type is critically examined, the generic status of this species cannot be determined. It is referred to *Lophiotoma* mainly on account of Martin's comparison of the species with *albina* Lamarck. No measurements were given.

Synonymy —

- 1883 *Pleutoma albinoides* Martin, Samml. Geol. Reichsmus., Leiden, 1, p. 227, pl. 10, figs. 23, 23a.
1921 *Pleutoma albinoides* Martin, Vredenburg, Rec. Geol. Surv. India 53(2), p. 97.

Lophiotoma abbreviata subspecies abbreviata (Reeve, 1843)

(Pl. 237, figs. 1, 2; pl. 238, figs. 1, 2)

Range — Mauritius to Fiji.

Remarks — This species closely resembles *acuta* except for the truncated anterior canal, more broadly conic spire and heavier sinus rib. The latter is composed of two strong, closely spaced, smooth spiral cords. The coloration is similar, except that the subsutural maculations are heavier.

This species seems to occur only in shallow water on coral reefs and in sandy pockets. A var-

iant in populations at Rodriguez Island, Mauritius and the Andaman Islands has the sinus rib less prominent, coupled with a pattern in which the speckles are more prominent and the subsutural maculations less so, but they seem to occur along with the typical form.

Description — Adult shell 25 to 36 mm. (1 to 1½ inches) in height. Spire 1.3 times the height of the aperture plus canal, angle 28° to 35°. Whorls 8 or 9, exclusive of the protoconch which is missing in

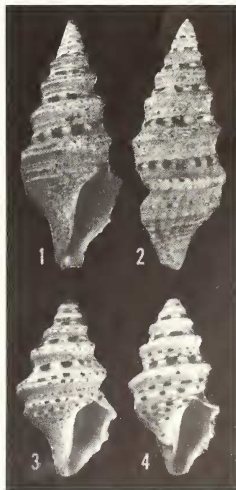


Plate 237. Figs. 1, 2, *Lophiotoma abbreviata* (Reeve). Near Suva, Viti Levu Id., Fiji. 36 mm. Figs. 3, 4, *abbreviata lifuensis* (Sowerby). Lifu Id., Loyalty Islands. 19 mm.

all examples examined. Spire rather broadly conic and strongly angulated at the middle by a bicarinate sinus rib. Spire whorls with a broadly convex subsutural fold and a secondary cord between the periphery and the lower suture. On the base there are two closely spaced primary cords or sub-keels, the uppermost emergent at the suture, plus 4 or 5 weaker primary cords on the middle area of the base, plus 5 or 6 from the neck to the tip of the anterior canal. The whole surface is crowded with fine, crisp, spiral threads. The sinus rib is composed of a pair of smooth rounded cords, with a slight concavity between. Aperture strongly lirate a little distance within the outer lip. Sinus narrow, of moderate depth. Colour creamy white, speckled with light-brown on the spirals, plus prominent dark-brown rectangular maculations which are serially arranged around the subsutural fold.

Measurements (mm.)—

height	width	
36.0 +	14.5	Fiji
32.0	12.3	Philippines
29.5	11.5	Fiji
26.5	11.0	Andaman Ids.
25.0	11.0	lectotype
24.5	10.5	Fiji

Synonymy—

- 1843 *Pleurotoma abbreviata* Reeve, Conch. Icon. 1, pl. 10, fig. 86.
 1884 *Pleurotoma abbreviata* Reeve, Tryon, Manual of Conch. 6, p. 167, pl. 3, fig. 25.

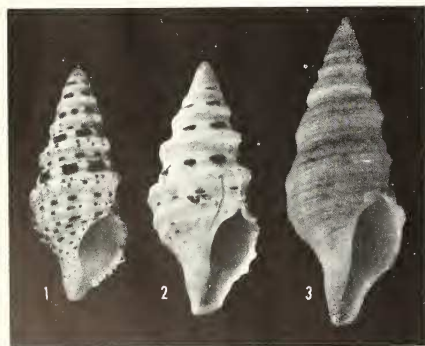


Plate 238. Figs. 1, 2, *Lophiotoma abbreviata* (Reeve, 1843). Two of four syntypes in the British Museum (Natural History). Reefs at low water, Masbate Island, Philippines. Lectotype, fig. 1, is 25 × 11 mm. Fig. 3, *L. abbreviata ustulata* (Reeve, 1846). Holotype, no locality, Brit. Mus., 31 × 12 mm.

*Types—*Lectotype, one of four syntypes here selected, is in the British Museum (Natural History).

*Records—*MAURITIUS: ex N. Pike (USNM); Rodriguez Id. (USNM). ANDAMAN ISLANDS: (USNM). HALMAHERA GROUP: Morotai (USNM). PHILIPPINES: Masbate Id., on reefs at low water (type); Mariveles, Bataan, Luzon Id. (ANSP); Lubang (Winckworth coll., Brit. Mus.). PALAU ISLANDS: S. end of Gorokottan Id.; 1 mi. S. of West Passage, Babelthuap Id. (ANSP). NEW CALEDONIA: Tonho Bay, 0-1 ft., fringe reef, with sand pockets; La Roche Percée, Bourail (ANSP). FIJI: ex Garrett (ANSP); Bega Id. (D. Thaanum coll.); reef at Suva, Viti Levu Id. (A. W. B. Powell coll.); Levuka, Vanua Levu Id. (USNM).

Lophiotoma abbreviata subspecies lifuensis (Sowerby, 1907)

(Pl. 237, figs. 3, 4)

*Range—*Lifu, Loyalty Islands.

*Remarks—*This form which is known only from the type locality of Lifu is much broader-spined and more squat than the typical subspecies. The peripheral keel is more prominently projecting and the two basal sub-keels are much stronger. It may be only an ecological form, but so far it has not turned up from other localities.

*Description—*Adult shell 17 to 20 mm. (about 1 inch) in height. Whorls 5+, exclusive of protoconch, missing in all examples examined. Spire a little more than the height of the aperture plus canal, angle 40° to 50°. Coloration and sculptural detail as in the typical subspecies, except that the peripheral keel, which is the sinus rib, strongly projects, flange-like, giving a ledged appearance to the shoulder.

Measurements (mm.)—

height	width	
19.7	10.0	
19 +	11.0	
17.0	10.0	holotype

Synonymy—

- 1907 *Pleurotoma abbreviata lifuensis* Sowerby, Proc. Mal. Soc. 7, p. 300, pl. 25, fig. 5.

*Records—*LOYALTY ISLANDS: Lifu (type locality); (ANSP, Brit. Mus.; USNM).

Lophiotoma abbreviata subspecies ustulata (Reeve, 1846)

(Pl. 238, fig. 3)

*Range—*Probably Indian Ocean, Mauritius and Andaman Islands.

*Remarks—*It is likely that this shell will prove to be a synonym of *abbreviata*, or at most a geographic subspecies of it. Reeve's type is from an

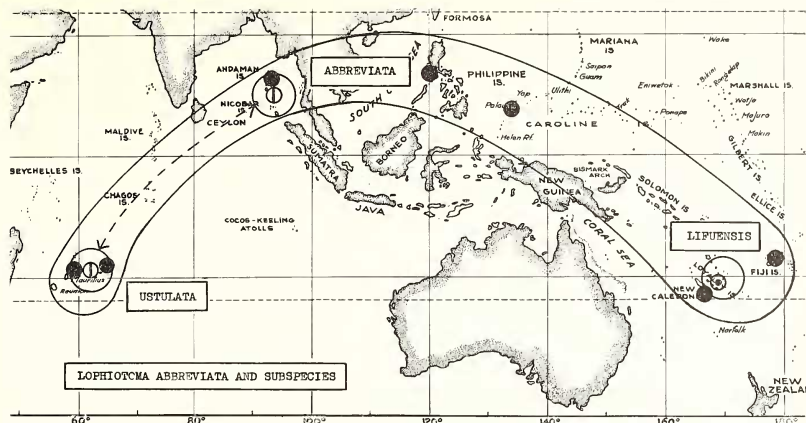


Plate 239. Geographical distribution of *Lophiotoma* (*Lophiotoma*) *abbreviata* (Reeve) and its subspecies *ustulata* (Reeve) and *lifuensis* (Sowerby).

known of this form it had better be admitted as a probable subspecies of *abbreviata*.

Measurements (mm.)—

height	width	
31	12	holotype

Synonymy—

1846 *Pleurotoma ustulata* Reeve, *Conch. Iconica* 1, pl. 40, fig. 369 (no locality).

1884 *Pleurotoma ustulata* Reeve, Tryon, *Manual of Conch.* 6, p. 167, "Mauritius."

Types—The holotype is in the British Museum (Natural History).

Records—INDIAN OCEAN: Mauritius; Andaman Ids. (USNM).

Lophiotoma ruthveniana (Melville, 1923)

(Pl. 240, fig. 2)

Range—Mauritius.

Remarks—This handsome shell appears closely allied to *abbreviata* and is distinguished from that species mainly by the overall strongly tessellated colour pattern. In *abbreviata* the larger maculations are confined to the subsutural fold but in *ruthveniana* the peripheral carina bears heavier maculations. In the absence of well-preserved apical whorls in the four examples seen, including the holotype, the species is only provisionally placed in *Lophiotoma*.

Description (from Melville)—"Shell fusiform, thick; whorls, especially the upper, somewhat compressed, being ten in number, inclusive of the two apical. Colour bright chestnut brown, with square, fairly regular, white tessellations on the spiral



Plate 240. Fig. 1, *Lophiotoma brevicaudata* (Reeve), Gulf of Suez. 22 mm. Fig. 2, *Lophiotoma ruthveniana* (Melville). Holotype. Mauritius. 41.5 mm.

unknown locality but similar shells are known from the two Indian Ocean localities mentioned above; not from the Pacific range of the typical species, however.

The type specimen is badly faded but the characteristic colour pattern of the typical species, particularly the subsutural maculations, is still discernable. The sculpture, however, is much weaker than is normal for *abbreviata*, the bicingulate peripheral keel being more like that of *acuta*; the anterior canal, however, is truncated. Until more is

carinae. These revolving keels appertain throughout—one, in particular, central, and subdivided by a shallow sulcus; the lesser tornate keels increase numerically in each of the lower whorls, till, on the body whorl, they total five or six, all beautifully variegated with white and chestnut alternately, as mentioned above. Mouth ovate-oblong, canal wide, abbreviate, sinus well developed, wide and deep, columellar margin fairly straight. Long. 41.5, lat. 14 mm.

"A handsome species, standing somewhat alone, and conspicuous for its bright coloration and tessellated carinal ornamentation."

Synonymy—

1923 *Turris rutheniana* Melvill, Proc. Mal. Soc. 15, p. 162, pl. 4, fig. 2.

Types—The type locality is Mauritius. The holotype is in the British Museum (Natural History), London.

Lophiotoma breviaudata (Reeve, 1843)

(Pl. 240, fig. 1)

Range—Gulf of Suez, New Guinea, the Philippines and New Caledonia.

Remarks—Three syntypes of Reeve's species are in the British Museum and there is little to add to his original description: "Shell shortly fusiform, solid, yellowish, brown at the base and apex; whorls convex, encircled with a single keel round the upper portion and a double keel round the lower; last whorl encircled with single and double keels alternately down to the base, lip simple and acute, sinus large; aperture small, short, canal rather short. Hab. Island of Ticao (found on reefs), Cuming."

It is an easily recognized little shell due to its regular smooth spirals and uniform yellowish brown colour, except for the brown staining of the anterior end. The apical whorls are eroded in all three syntypes.

Tryon (1884, p. 169) made this species a synonym of *fascialis* Lamarck = *polytropa* Helbling, but they are certainly not con-specific.

Apart from the type material and imperfect specimens from New Guinea and New Caledonia, the best preserved example seen is one from the Gulf of Suez (ex McAndrew coll., Brit. Mus.) in the Museum of Comparative Zoölogy, Harvard, and a description of the specimen follows:

Description (Red Sea specimen)—Adult shell 22 mm. (slightly under 1 inch) in height, fusiform, with a tall spire, but with a relatively short anterior canal. Whorls 7, exclusive of the protoconch, sufficient of which remains in one specimen to indicate that it is narrowly conic of several whorls. Spire 1.3 times the height of the aperture plus canal. Adult sculpture of narrow, sharp cords and threads, one cord on a moderately inflated subsutural fold, five threads over a deeply concave shoulder. There is a double-corded peripheral keel, enclosing a concave interspace with a single thread in the middle. There is one primary cord and two threads between the peripheral carina and the lower suture. Three cords, stronger than the rest, are on the upper part of the base, with each interspace having three threads, followed by an alternation of cords and threads over the neck, and finally closely-spaced threads over the anterior canal. Sinus deep, U-shaped, on the peripheral carina. Colour pale yellowish buff, with all the spirals continuously lined in light-brown and with a dark-brown staining on the anterior canal.

Measurements (mm.)—

height	width	
24.0	8.3	lectotype
22.2	7.6	Gulf of Suez

Synonymy—

- 1843 *Pleurotoma breviaudata* Reeve, Conch. Iconica 1, pl. 15, fig. 126.
1884 *Pleurotoma fascialis* Lamarck, Tryon, Manual of Conch. 6, p. 169 (non Lamarck, 1822).

Types—British Museum (Nat. Hist.), three syntypes, lectotype, 24 × 8.3 mm., here selected. The type locality is Ticao Id., Philippines, Hugh Cum-
ing, collector.

Records—PHILIPPINES: Ticao Id. (type locality); Calapan, Mindoro Id. (MCZ). NEW CALEDONIA: (Australian Mus.). WEST NEW GUINEA: Geelvink Bay, ½ mi. S. of Maroepi, Ambai, Japen Id., 14-25 fms., blue mud, shell and coral (ANSP). RED SEA: Gulf of Suez (MCZ).

Subgenus *Lophioturris* new subgenus

Type: *Turris indica* Röding, 1798

The adult shell is identical to that of typical *Lophiotoma*, in that it is fusiform, with a tall spire, usually with a long straight anterior canal, and with a deep and narrow sinus situated on the peripheral keel. However, the protoconch is paucispiral, blunt-tipped, smooth and rounded.

I hereby designate *Turris indica* Röding, 1798, as the type of this new subgenus.

Lophiotoma indica (Röding, 1798)

(Color pl. 175, figs. 2, 3, 9, 16; pl. 242)

Range — Ceylon to Australia and Fiji.

Remarks — This shell is better known by the name *Pleurotoma marmorata* Lamarck, 1822, a name, however, which cannot be used because Lamarck had already employed it in 1816 for a different shell which now falls under the synonymy of *Lophiotoma acuta* (Perry).

MacNeil (1960, p. 101) referred this species to his new genus *Unedogemmula* (type species, *unedo* Kiener), but *indica* has a paucispiral, smooth, dome-shaped protoconch and none of the examples I have seen exhibit granulation of the peripheral keel at any stage of growth. The diagnostic characteristics for *Unedogemmula* are a conical, multi-spiral protoconch, as in *Gemmula*, and there are peripheral gemmules on the early whorls, sometimes persisting over all the whorls.

Sowerby, 1888, p. 211, described a *Pleurotoma bulowi* from the China Sea as follows: "P. testa

elongata-fusiformi utrinque attenuata, pura alba. Anfractus 13, primi 2 rotunde convexi, politi; caeteri acute carinati, ubique dense spiraliter lirati; spira acutissima. Anfractus ultimus leviter convexus, ad basin valde contractus et multo productus. Apertura ovata, sinu elongato, angusto emarginata; canali gracili, elongato. Long. 35, maj. diam. 10."

"A pure white, keeled, and closely ridged species of the typical form of *P. babylonica*."

A specimen labelled *bulowi*, from Hong Kong, in the British Museum, not the type which could not be found, is here figured. Bleached and eroded examples from Darwin, N.W. Australia are of similar appearance to the above and others from Gladstone, Queensland, are pure white also, but not eroded, which suggests that *bulowi* is merely an albinistic form of *indica*. Typical maculated shells occur within the range of these albino records.

Description — Adult shell 85 to 93 mm. (about 3 to 4 inches) in height, elongate-fusiform, with a tall spire and a long, straight anterior canal, closely simulating *Fusinus*. Whorls 14, plus a small blunt, smooth, paucispiral protoconch of 1½ whorls, followed by a half-whorl of brephic axials. Sculpture consisting of a strong but narrowly-rounded, smooth, peripheral carina located at a little below median whorl height, a subsutural fold carrying a moderately strong smooth spiral cord at its lower extremity, plus a weaker cord and several threads above it. One to three smooth primary spiral cords are present between the periphery and the lower suture, and there are 18 to 20 primary spirals on the body whorl from the periphery to the end of the anterior canal. The whole of the interstitial surface is crowded with smooth, spiral threads of varying

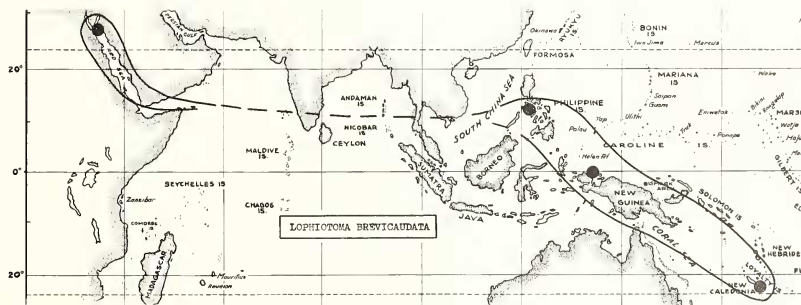


Plate 241. Geographical distribution of *Lophiotoma* (*Lophiotoma*) *brevicaudata* (Reeve).

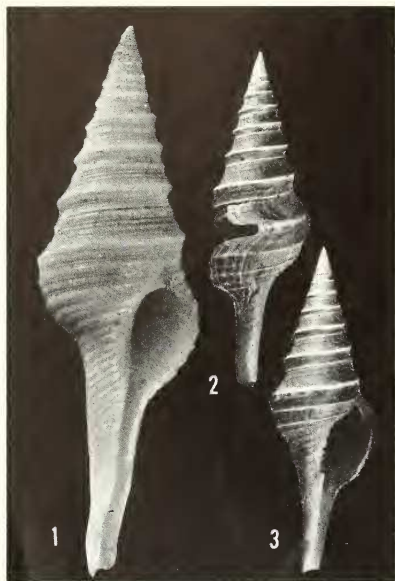


Plate 242. Fig. 1, *Lophiotoma (Lophioturris) indica* (Röding). Cotype of *Pleurotoma bulowi* Sowerby, 1888. Hong Kong (Brit. Mus. (Nat. Hist.)). Figs. 2, 3, *L. (Lophioturris) leucotropis* (Adams and Reeve). 60 fms., off Kii, Japan.

strength. Spire a little less than the height of the aperture plus canal. Colour pattern profusely spotted with dark-brown on a white ground. The maculations are confined to the primary spirals but they diffuse vertically and present a sinuous axial pattern, giving a marbled effect. The peripheral maculations are stronger than the others. In some examples the markings resolve into continual sinuous axial flames.

Measurements (mm.)—

height	width	spire angle	
91.7	23.0	30°	Philippines
85.0	24.5	32°	New Guinea
70.5	18.5	30°	New Guinea

Synonymy—

- 1798 *Turris indica* Röding, Museum Boltenianum, Hamburg, pt. 2, p. 124, based upon Conch. Cab. 4, pl. 145, figs. 1345, 1346.
 1822 *Pleurotoma marmorata* Lamarck, Hist. Nat. anim. sans Vert. 7, p. 95 (non 1816).
 1839–40 *Pleurotoma marmorata* Lamarck, Kiener, Coq. Viv., Pleurotome, p. 9, pl. 6, fig. 1; pl. 7, fig. 2.
 1842 *Pleurotoma neglecta* Reeve, Conch. Syst. 2, p. 189, pl. 235, fig. 2.
 1843 *Pleurotoma marmorata* Lamarck, Reeve, Conch. Icon. 1, pl. 3, figs. 21a, b. (Straits of Malacca, 10 fms.).

- 1888 *Pleurotoma bulowi* Sowerby, Proc. Zool. Soc., p. 211, pl. 11, fig. 16.
 1895 *Pleurotoma gendinganensis* Martin, Samml. Geol. Reichsmus., Leiden, new folio—p. 32, pl. 5, figs. 79–84.
 1915 *Pleurotoma gendinganensis* Martin, Tesch, Pal. Timor 5, p. 23, pl. 75, figs. 30–33.
 1922 *Turris indica* Röding, Hedley, Rec. Australian Mus. 13(6), p. 215.
 1948 *Turris indica* Röding, Cox, Schweizer Pal. Abhandl. 66, p. 54, pl. 5, figs. 8a, b.
 1956 *Lophiotoma marmorata* Lamarck, Kaicher, Indo-Pacific Sea Shells, pt. 5, Toxoglossa, pl. 1, fig. 4.
 1960 *Unedogemmula indica* Röding, MacNeil, U.S. Geol. Surv. Prof. Paper 339, p. 101 (but not the Okinawa Pliocene record which has gemmate early whorls).
 1961 *Turris (Polystira) indica* Röding (sic = *Polystira*). Habe, Coloured Illustr. Shells of Japan 2, pl. 38, fig. 20.

Records—CEYLON: Trincomalee (USNM). JAVA: (ANSP). CELEBES: Buton Strait, S.E. of Tikola Peninsula, 37 fms., grey mud (Albatross Sta. 5642). MALACCA: (ANSP). THAILAND: 4 mi. E. of Phuket Harbour, 80 ft. (R. Tucker Abbott). PHILIPPINES: Cuyo Id., Palawan; Badang near Gubat, Sorsogon Province, S. Luzon Id. (du Pont-Acad. Exped., ANSP); Cebu Id.; 28 fms., off Polloc, Mindanao Id.; W. of Bucas Grande Id., 44 fms.; off Corregidor Id., 28 fms., grey mud; off Dumalag Id., Davao, Mindanao Id., 100 fms., soft mud (Albatross, USNM). NEW GUINEA: Hoods Bay (D. Thaanum coll.). JAPAN: Hirado Hizen (USNM). FIJI: Suva (USNM); Suva Point (D. Thaanum coll.). AUSTRALIA: Onslow, N.W. Australia (A. W. B. Powell coll.); Damley Id., 25 fms., and Cape York (Hedley, 1922).

Fossil Records—If the material has been correctly assigned, the species *indica* has a time range from the Miocene to the Recent. MIOCENE: Tjilang, Java. PLIOCENE: Java, Sumatra, Timor and Ceram Ids. NEOGENE: Philippines; British North Borneo. QUATERNARY: Celebes (Cox, 1948).

MacNeil (1960, p. 102) doubts if all the specimens figured by Martin (1895) and Tesch (1915) are conspecific or even congeneric. None, however, from the figures, show peripheral gemmation. Only an examination of the actual material can elucidate the situation. Although the Javanese Pliocene *Pleurotoma gendinganensis* Martin is included in the above synonymy, on the authority of Cox, a doubt is raised regarding the true generic location of Martin's species by a long series of specimens in the British Museum, from Kolo, Timor (Pliocene), which, although ascribed to *gendinganensis*, have the nuclear and early spire gemmulation of *Unedogemmula*. Critical re-examination of Martin's type specimen is now necessary to determine the exact status of *gendinganensis*.

Lophiotoma leucotropis (Adams & Reeve, 1850)

(Color pl. 175, figs. 4, 5; pl. 242)

Range—Recent, Japan, China, Hong Kong and Philippines. Fossil, Okinawa (Miocene-Pliocene); Formosa (Pliocene).

Remarks—This species has been frequently misidentified as *oxytropis* (Sowerby), but that species is confined to Panama and Central America, and belongs to *Polystira*, a genus with a shallower, widely open peripheral sinus.

Description—Adult shell 50 to 66 mm. (2 to 2½ inches) in height, solid, elongate-fusiform, carinate. Spire about equal to the length of the aperture plus canal, angle 28° to 30°. Whorls 11 or 12, plus a

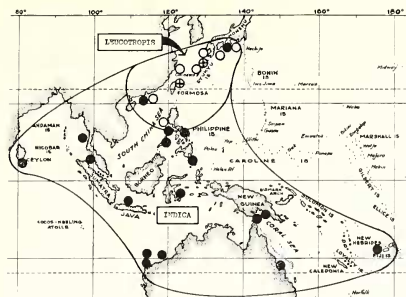


Plate 243. Geographical distribution of *Lophiotoma* (*Lophioturris*) *indica* (Boding) in solid dots and *leucotropis* (Adams and Reeve) in open circles.

small, smooth, blunt, paucispiral protoconch of $1\frac{1}{2}$ whorls, followed by a half-whorl of brephic axials. Post-nuclear sculpture of a thin, sharply raised, subsutural cord; the peripheral keel which is a broad, smooth, projecting sinus rib is situated below the middle of whorl height, and 0 to 2 smooth spiral cords are emergent between the sinus rib and the lower suture. On the base, from below the sinus rib, there are about 8 primary cords and a variable number of spiral threads; the uppermost four of the primary cords are more prominent than the others. Sinus deep, on the peripheral cord. Colour uniformly light golden brown with the spirals white. Operculum leaf-shaped with an apical nucleus.

Measurements (mm.) —

height	width	
66.0	19.0	all Japan
53.8	16.4	
51.0	15.3	
49.2	15.2	
46.8	13.8	

Synonymy —

- 1850 *Pleurotoma leucotropis* Adams & Reeve, Zool. Voy. Samarang, p. 40, pl. 10, fig. 7.
 1904 *Lophiotoma leucotropis* Adams & Reeve, Casey, Trans. St. Louis Acad. Sci. 14(5), p. 130.
 1928 *Pleurotoma oxytropis* Schumacher, Yokohama, Imp. Geol. Surv. Japan Rep. 101, p. 31, pl. 1, fig. 11 (non Schumacher).
 1951 *Turris leucotropis* Adams & Reeve, Taki, Handb. Illustr. Shells Japan (Hirase, revised Ed.), pl. 115, fig. 3.
 1960 *Lophiotoma* cf. *leucotropis* Adams & Reeve, MacNeil, U.S. Geol. Surv. Prof. Paper 339, p. 100, pl. 5, figs. 8, 9; pl. 14, figs. 15, 21.
 1961 *Turris leucotropis* Adams & Reeve, Habe, Coloured Illustr. Shells Japan 2, pl. 38, fig. 19.

Types — The type locality is the China Sea.

Records — JAPAN: Tosa; Kii; Sagami Bay; Tokyo Harbour (ANSP); Kii, 60 fms.; Wakanura; Fukura; Awaji; Enoshima; Suruga Gulf (USNM). RYUKYU ISLANDS: (ANSP). CHINA: Fukien Province (ANSP). ANNAM: Ba Lang (A. W. B. Powell coll.); HONG KONG: (USNM and MCZ). PHILIPPINES: Baler, Tayabas, Luzon Id. (MCZ).

Fossil Records — OKINAWA: Yonabaru clay (Miocene); Shinzato tuff (Miocene or Pliocene). FORMOSA: Byoritzu beds (Pliocene) (MacNeil, 1960, p. 100).

Lophiotoma polytropa (Helbling, 1779)

(Color pl. 175, figs. 10, 11; pl. 244)

Range — Philippines, Moluccas and New Caledonia, shallow water.

Remarks — It is unfortunate that the name *fascialis* Lamarck, so long in use for this well-known shell, has to be supplanted by Helbling's earlier name *polytropa*. Helbling's figure of this shell is unmistakable and the description full and adequate. It is even more unfortunate that recent Japanese writers have misapplied the name *polytropa* to a form of *deshayesii* (Doumet, 1834) (see under *Unedogemmula*). It is no doubt the obscurity of Helbling's reference that has resulted in the belated recognition of *polytropa*.

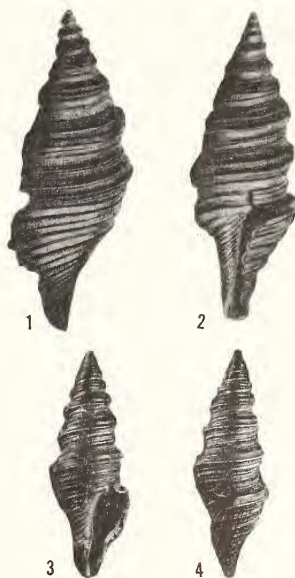


Plate 244. Figs. 1-4, *Lophiotoma* (*Lophioturris*) *polytropa* (Helbling). Figs. 1, 2, original Helbling figures, pl. 2, figs. 24, 25. Figs. 3, 4, Philippine Islands. 46 mm. (photo by V. Orr).

This species is generally found in shallow water in pockets in the reef where the bottom is of sand, silt and weed.

Description—Adult shell 42 to 50 mm. (1½ to 2 inches) in height, solid, with a tall spire and a short canal; dark purplish brown; encircled with prominent but narrow, sharply raised spiral cords. Whorls 9 or 10 (exclusive of the protoconch, eroded in all available specimens). Spire tall, 1½ times the height of the aperture plus canal, angle 27° to 30°. Spire whorls sculptured with strong, narrowly rounded, spiral cords and interstitial threads. Firstly, a single primary cord just below the suture, then a deeply concave shoulder which flares out almost horizontally to a prominent bi-cingulate sinus rib, situated above the mid point of the whorl. The spirals delimiting the sinus area are relatively wide-spaced, with a concavity between. Walls below the sinus area straight and undercut, bearing one or two primary cords and a secondary spiral in each interspace. On the base from below the sinus area there are about seven primary cords, each with a secondary spiral in between, plus a further 7 or 8 closer-spaced spiral cords on the neck and fasciole. Two to four fine spiral threads occupy the shoulder concavity. Sinus deep and located on the peripheral keel. Colour either uniformly dark purplish brown or with the addition of a pale-grey zone extending from the sinus ribs to just below the top of the aperture. Spiral cords crossing this pale zone are, however, lined in dark-brown. The interior of the aperture is dull bluish grey.

Measurements (mm.)—

height	width	
50.3	17.0	Philippines
50.0	17.0	type of <i>elegans</i> Wood
46.0	16.0	Philippines
42.0	14.0	Philippines

Synonymy—

- 1779 *Murex (Fusus) polytropus* Helbling, Abhandl. Priv. Bohm. Math. Prag. 4, p. 119, pl. 2, figs. 24, 25.
 1822 *Pleurotoma fascialis* Lamarck, Anim. sans Vert. 7, p. 93.
 1828 *Murex elegans* Wood, Index Test., Suppl., p. 15, pl. 5, fig. 8b (no locality).
 1839-40 *Pleurotoma fascialis* Lamarck, Kiener, Coq. Viv., Pleurotome, p. 27, pl. 4, fig. 2 ("Red Sea").
 1843 *Pleurotoma fascialis* Lamarck, Reeve, Conch. Icon. 1, pl. 4, fig. 24a, b. (Philippines).
 1884 *Pleurotoma fascialis* Lamarck, Tryon, Manual of Conch. 6, p. 169, pl. 4, fig. 40.
 1956 *Lophiotoma fascialis* Lamarck, Kaicher, Indo-Pacific Sea Shells, Section 5, Toxoglossa, pl. 1, fig. 3.

Types—British Museum (Natural History) (*elegans*). The where-abouts of Helbling's type is unknown to me.

Records—PHILIPPINES: Batangas, Luzon Id.; N. end San Miguel Id., Tabaco, Albay Province, Luzon Id.; mud-flat on island in Tabaco Harbor; Cebu (duPont-Academy Exped., 1958); Samar Id.; Davao Bay, Mindanao Id.; Mindoro (USNM); Lubang Id. (MCZ). MOLUCCAS: (ANSP). NEW CALEDONIA: 4-12 fms., Noumea (G. and M. Kline, ANSP).



Plate 245. Geographical distribution of *Lophiotoma (Lophioturris) polytropa* (Helbling).

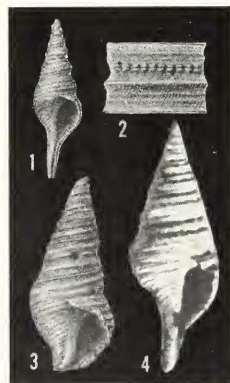


Plate 246. Figs. 1, 2, *Lophiotoma (Lophioturris) albinoides* (Martin). Lower Miocene of Njalindeong beds, Java Id., Indonesia (from K. Martin, 1883, pl. 10, figs. 23, 23a). Fig. 3, *L. (Lophioturris) pseudofascialis* Martin. Lower Miocene of Java Id., Indonesia (from K. Martin, 1883, pl. 10, fig. 22). Fig. 4, *Lophiotoma* species A, "*Pleurotoma fascialis*" Abard, 1942, pl. 8, fig. 4. Pleistocene, Somalia.

Lophiotoma pseudofascialis (Martin, 1883)

(Pl. 246, fig. 3)

Range — Java, Lower Miocene.

Remarks — As the author of this species states, this species could be closely related to the Recent "*fascialis* Lamarck" (i.e. *polytropa* Helbling, 1779). It seems to differ only in the peripheral keel being less prominent. No measurements were given.

Synonymy —

1883 *Pleurotoma pseudofascialis* Martin, Samml. Geol. Reichmus., Leiden, 1, p. 226, pl. 10, fig. 22.

Records — JAVA: Tji Longan near Selatjau (Njalindoeng beds, Lower Miocene).

Lophiotoma odengensis (Martin, 1895)*Range* — Upper Miocene of Java.

Remarks — This species was compared with *Pleurotoma gendinganensis* Martin, 1895, by its author, but from the illustration the species appears to be more nearly allied to *leucotropis* (Adams and Reeve, 1850).

Synonymy —

1895 *Pleurotoma* (s.str.) *odengensis* Martin, Die Fossilien von Java, Samml. Geol. Reichsmus., Leiden, p. 33, pl. 5, figs. 85, 86; pl. 6, fig. 87.

Records — JAVA: Kampong Odeng, Palabuan district (Upper Miocene).

Lophiotoma species A

(Pl. 246, fig. 4)

Range — Somali Coast, Pleistocene.

Remarks — This species was recorded by Abrard as the Recent "*Pleurotoma fascialis* Lamarck" (i.e. *polytropa* Helbling, 1779), but it has a shorter spire and more rounded whorls. Its whorls have more the outline of those of *pseudofascialis* (Martin, 1883) from the Lower Miocene of Java, but that species is more attenuate. When more material is available, this Somali fossil will probably prove to be a new species.

Synonymy —

1942 *Pleurotoma fascialis* Lamarck, Abrard, Archiv. du Mus. D'Hist. Nat. (ser. 6) 18, p. 86, pl. 8, fig. 33 (non Lamarck, 1822).

Records — SOMALIA: Ravin de Baghenda, Obock, 1500 metres, Pleistocene.

Genus Pleuroliria de Gregorio, 1890*Type*: *Pleurotoma supramirifica* Gregorio, 1890

Very similar to the Miocene-Recent, *Polystira*, and evidently a forerunner of that genus. Smaller than *Polystira*, with a less prominent peripheral keel. The chief difference is in the protoconch which is of about four whorls, the first very small, the last $2\frac{1}{2}$ with numerous axial riblets. Eocene and Oligocene, southeastern United States.

Synonymy —

1890 *Pleuroliria* de Gregorio, Monogr. Faune Eocene Alabama, Annales de Geol. et de Palcont., Palermo 7, p. 38. *Type* by original designation: *Pleurotoma* (*Pleuroliria*) *supramirifica* de Gregorio.

Characteristic Species —

OLIGOCENE: *cochlearis* Conrad, 1847; *submissilis* Casey, 1904; *wayneensis* Mansfield, 1890. EO-CENE: *crenulosa* Casey, 1904; *jacksonella* Casey, 1904; *simplex* Casey, 1904; *subdeciata* Gregorio, 1890; *supramirifica* Gregorio, 1890; *tizis* Gregorio, 1890.

Genus Polystira Woodring, 1928*Type*: *Pleurotoma albidia* Perry, 1811

This genus is the Panamic-Caribbean equivalent of the Indo-Pacific *Lophiotoma*. Its range extends from the Miocene to the Recent.

The type species, *albidia* Perry, was erroneously recorded by its author from the "South Seas, being frequently found at New Zealand and Lord Hood's Island." It is, however, confined to the Caribbean, and the rather numerous instances of this shell in museum collections, with Indo-Pacific localities cited, can be disregarded. It was common practice among dealers to attach the locality of the original reference or assumed locality whenever the actual source of a specimen was not known.



Plate 247. Radula of *Polystira albidia* (Perry). Caribbean, Recent (prepared and drawn by J. P. E. Morrison, U.S. Nat. Mus.).

Shell large, up to 110 mm. ($4\frac{1}{2}$ inches) in height, elongate-fusiform, very solid, sculptured with numerous smooth spiral keels. Protoconch stout, cylindrical, of about two whorls, last $\frac{1}{4}$ whorl axially ribbed. Sinus on the peripheral carina, shallow, broadly V-shaped. Operculum leaf-shaped with apical nucleus. Radula, a pair of "wishbone"-shaped marginals. (See pl. 247).

Synonymy —

1928 *Polystira* Woodring, Publ. no. 385, Carnegie Inst.

Washington, p. 145. Type by original designation: *Pleurotoma albida* Perry.

Characteristic Species —

RECENT: *albida* Perry, 1811 (= *virgo* Wood, 1818); *albicarinata* Sowerby, 1870; *formosissima* Smith, 1915; *nobilis* Hinds, 1843; *oxytropis* Sowerby, 1834; *picta* Reeve, 1843; *tellea* Dall, 1889; *vibex* Dall, 1889. PLIOCENE: *panamensis* Olsson, 1942. MIOCENE: *barretti* Guppy, 1866.

The *Xenuroturris* Group

Relationship appears to have existed within a group of Miocene to Recent Austro-Neozelanic genera which exhibit either alliance to or analogy with the wide-ranging Indo-Pacific Pliocene to Recent *Xenuroturris*.

Of the five genera in this group only *Xenuroturris* has a polygyrate protoconch; the others have a blunt cylindrical-sided, paucispiral protoconch, the tip smooth, followed by regular or brephic axials.

The New Zealand Miocene *Echinoturris* has a relatively short canal and distinctive sculpture of a bicarinate series of sparse prickly nodules. The V-shaped sinus is on the upper carina.

The southern Australian Miocene to Pliocene *Veruturris* has a relatively short canal compared with *Turris* but not truncated to the extent exhibited by *Xenuroturris*.

A third group, for which a new subgenus *Cinguliturris* is provided, is represented by the Australian Miocene (Balcombian) species *Asthenotoma tatei* Cossmann, which is *Xenuroturris*-like with its truncated canal but has a paucispiral protoconch and the sinus rib as a simple spiral cord, not duplicate or margined in any way.

Finally, the New South Wales Recent species, *Xenuroturris corona* Laseron, for which a new genus *Viridoturris* is provided, is another member of the paucispiral-apiced group, standing nearest to *Xenuroturris* in its truncated anterior end and de-

fined sinus rib, but lacking the characteristic polygyrate, axially costate protoconch of that genus.

If the above association of genera is a correct assumption, it would then appear that these presumed offshoots have arisen independently at different times in two areas marginal to the present tropical Indo-Pacific range of *Xenuroturris* typical.

Genus *Echinoturris* Powell, 1942

(Pl. 248)

Type: "*Turris*" *finlayi* Powell, 1935

The genus is so far known only by one species, the type locality for which is volcanic tuffs of Altonian Miocene age from Motutara, west coast, Auckland, New Zealand.

The genus is characterised by small size, 8 to 10 mm., moderately long canal, blunt, round-topped, cylindrical-sided, smooth protoconch of two whorls, ending with a few closely spaced thin axials.

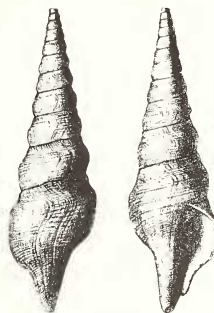


Plate 248. *Echinoturris finlayi* (Powell). Holotype. Altonian Miocene of Motutara, Auckland, New Zealand.

Key to the *Xenuroturris* group

Protoconch polygyrate	
Sinus rib margined	
Canal truncated	<i>Xenuroturris</i>
Protoconch paucispiral	
Sinus rib margined or defined	
Canal truncated	<i>Viridoturris</i> nov.
Canal moderately long	<i>Veruturris</i>
Sinus rib not margined	
Canal short	
Sculpture cingulate	<i>Cinguliturris</i>
Canal moderately long	
Sculpture bicarinate-spinose	<i>Echinoturris</i>

The most distinctive features are the bicarinate series of sparse prickly nodules and the rather deep V-shaped sinus situated on the upper carina, which like the lower carina is a simple rounded cord, not margined. The relationship, if any, with *Xenuroturrus* is certainly not close.

Synonymy —

1942 *Echinoturrus* Powell, Bull. 2, Auckland Inst. and Mus., p. 50. Type by monotypy: "*Turris*" *fulayi* Powell, 1935 (Awamoa, Middle Miocene, New Zealand).

Genus *Veruturris* Powell, 1944

Type: *Xenuroturrus* (*Veruturris*) *quadricarinatus* Powell, 1944

This is a Miocene-Pliocene group from South Australia and Victoria, characterised by moderate size, 14 to 50 mm., a tall spire but only moderately long canal; paucispiral blunt protoconch of 2 to 2½ smooth whorls followed by a half-whorl or so of brephic axials. Sinus deep, broadly V-shaped, on sinus rib situated above the middle of whorl height. This rib may be a single cord as in the type species and as in *tomopleuroides*, or two almost fused cords. The genus *Xenuroturrus* differs in having a polygyrate protoconch and a very short anterior canal.

The species of this genus and other turrid representatives of the Australian Tertiary are included since they are members of past faunas climatically analogous to the present tropical Indo-Pacific fauna.

Synonymy —

1944 *Veruturris* Powell, Records Auckland Inst. and Mus. 3(1), p. 9 (subgenus). Type by original designation: *Xenuroturrus* (*V.*) *quadricarinatus* Powell, 1944.

Veruturris bisculpta (Powell, 1944)

Range — Abattoirs (type locality) and Weymouth Bores, Adelaide, Adelaidean, Lower Miocene.

Remarks — Upper half of spire whorls sculptured with about 17 vertical fold-like axials, crossed by three spiral cords which are rendered nodulose by the axials; lower half of each whorl with 2 or 3 heavy, closely spaced, plain spirals. Sinus area a deep narrow groove between two of the cords at about two-thirds whorl height.

Measurements (mm.) —

height	width	
26.7	6.5	
13.9	4.5	holotype



Plate 249. *Veruturris subconcata* (Harris). Miocene, Janjikian, of Victoria, Australia (from Harris, 1897, pl. 3, figs. 2a, b).

Synonymy —

1944 *Xenuroturrus* (*Veruturris*) *bisculptus* Powell, Rec. Auck. Inst. Mus. 3(1), p. 11, pl. 1, fig. 4.
1958 *Xenuroturrus* (*Veruturris*) *bisculptus* Powell, Ludbrook, Trans. Royal Soc. South Australia 81, p. 85.

Types — The holotype is in the Auckland Museum (Finlay collection).

Veruturris cochleata (Powell, 1944)

(Pl. 250)

Range — Balcombian, Miocene of Muddy Creek, lower beds, Victoria (type locality); Altona shaft and Clifton Beach, Victoria.

Remarks — Spire whorls with strong narrowly rounded cords, one linear-spaced pair submarginating the suture, then a second pair, forming the sinus rib, situated at three-quarters whorl height, followed by five or six smooth, rounded, spiral cords. Sinus narrowly V-shaped.

Measurements (mm.) —

height	width
52	14

Synonymy —

1944 *Xenuroturrus* (*Veruturris*) *cochleatus* Powell, Rec. Auck. Inst. Mus. 3(1), p. 10, pl. 7, fig. 11.

Types — The holotype is in the Auckland Museum (Finlay collection).

Veruturris quadricarinata (Powell, 1944)

Range — Balcombian, Miocene of Muddy Creek, lower beds, Victoria (type locality), and Altona shaft, Victoria.

Remarks — Spire whorls with evenly spaced, strong, rounded cords, middle pair stronger than the other two. Sinus broadly V-shaped, situated on upper of the middle pair of cords.



Plate 250. *Veruturris cochleata* Powell. Balcombian Miocene of Muddy Creek, Victoria, Australia. 52 mm.

Measurements (mm.)—

height	width
14.5	4.2

Synonymy—

1944 *Xenuturris* (*Veruturris*) *quadracaratus* Powell, Rec. Auck. Inst. Mus. 3(1), p. 11, pl. 1, fig. 5.

Types—The holotype is in the Auckland Museum (Finlay collection).

Veruturris subconcava (Harris, 1897)

(Pl. 249)

Range—Janjikian Miocene, Victoria. Locality cited "Merribee River" = Werribee River; probably incorrect.

Remarks—The largest member of the genus, resembling *cochleata* in shape and size but much more smoothly and finely sculptured.

Measurements (mm.)—

height	width
58	16

Synonymy—

1897 *Pleurotoma subconcava* Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 41, pl. 3, figs. 2a, b.

1944 *Xenuturris* (*Veruturris*) *subconcava* Harris, Powell, Rec. Auck. Inst. Mus. 3(1), p. 10.

Types—The holotype is in the British Museum (Natural History) in London.

Veruturris tomopleuroides (Powell, 1944)

Range—Abattoirs (type locality) and Weymouth Bore, Adelaide, South Australia, Adelaidean, Lower Mid-Pliocene.

Remarks—Spire whorls with two spiral threads submarginating the suture, a moderately strong cord at three-fourths whorl height and the peripheral carina at less than one-third whorl height, followed by a third strong spiral at the lower suture. Sinus rib not margined.

Measurements (mm.)—

height	width
17.5	5.5

Synonymy—

1944 *Xenuturris* (*Veruturris*) *tomopleuroides* Powell, Rec. Auck. Inst. Mus. 3(1), p. 11, pl. 1, fig. 3.

1958 *Xenuturris* (*Veruturris*) *tomopleuroides* Powell, Ludbrook, Trans. Royal Soc. South Australia 81, p. 84.

Types—The holotype is in the Auckland Museum (Finlay collection).

Subgenus *Cinguliturris new subgenus*

Type by monotypy: *Asthenotoma tatei* Cossmann, 1896

This subgenus is known only by the type species which comes from the Muddy Creek lower beds and other localities of the Balcombian Miocene of Victoria. It resembles *Xenuturris* in the truncation of the base and anterior canal but has a blunt paucispiral smooth protoconch followed by a full whorl of strong brephic axials.

A feature of the subgenus is the evenly developed, strong, spiral cinguli, the one bearing the sinus being neither different from the others in size nor is it margined or duplicate.

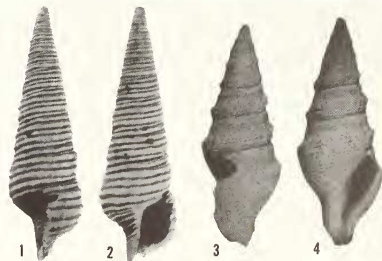


Plate 251. Figs. 1, 2, *Veruturris* (*Cinguliturris*) *tatei* (Cossmann). Balcombian Miocene of Muddy Creek, Victoria, Australia, 22 mm. Figs. 3, 4, *Viridoturris corona* Lase-ron. Holotype. 50-70 fms., off New South Wales, Australia.

***Veruturris tatei* (Cossmann, 1896)**

(Pl. 251, figs. 1, 2)

Range — Balcombian Miocene of Muddy Creek lower beds (type locality) and other localities in Victoria, Australia.

Description — Protoconch paucispiral, blunt, depressed at tip, of 2½ whorls, first smooth, followed by axials rendered subnodose at the periphery. The most striking feature of the shell is the evenly developed, sharply raised, spiral cinguli, 4 or 5 on the spire whorls, with the sinus rib second from the top, not differentiated in any way. The anterior canal is short as in *Xenuroturris*.

Measurements (mm.) —

height	width	
22.0	7	Balcombe Bay, Victoria
17.6	6	Balcombe Bay, Victoria
15.0	4	holotype of <i>tatei</i>
10.5	4	holotype of <i>trilineata</i>

Synonymy —

- 1896 *Asthenotoma tatei* Cossmann, Essais Pal. Comp. 2, p. 173, pl. 6, fig. 29.
 1897 *Pleurotoma trilineata* Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 40, pl. 3, figs. 1a-d.
 1898 *Asthenotoma tatei* Cossmann, Tate, Proc. Roy. Soc. N.S.W. 31, p. 398.
 1944 *Xenuroturris tatei* Cossmann, Powell, Rec. Auck. Inst. Mus. 3(1), p. 9.

Types — The type of *trilineata* Harris is in the British Museum (Natural History).

Genus *Viridoturris* new genus

Type by monotypy: *Xenuroturris corona* Laserson, 1954

This genus is known only by the type species which is a Recent shell from 50 to 70 fathoms off Green Cape, New South Wales. It is similar in facies to *Xenuroturris* except for the protoconch which is paucispiral, a broad smooth dome of one whorl followed by less than one whorl of axial

threads. There is a well-defined sinus rib margined by a pair of sharply raised spirals.

The genus is probably a modern local offshoot from *Xenuroturris*, again indicating a tendency for mutations to occur in areas marginal to the tropical Indo-Pacific area of distribution for the group.

***Viridoturris corona* Laserson, 1954**

(Pl. 251, figs. 3, 4)

Range — Recent, New South Wales, 50 to 70 fathoms off Green Cape.

Remarks — Since Laserson's pen and ink sketches often give a misleading impression of sculptural detail, due to stylised treatment, his full and adequate description is given also.

"Shell of moderate size, conical with a long spire, pure white. Protoconch blunt, a broad, smooth, dome-shaped apex, followed by a short whorl with axial threads. Mature whorls 6, sharply angled at the periphery, the shoulder broad and concave, base not excavate. Sculpture predominantly spiral, of numerous strong cords, fine threads on the shoulder and columella. The peripheral cord and to a lesser extent the one below it are broken into elongated laminae, the others are nearly smooth, except where indented by the fine axial threads. These cross the whorls obliquely and are most marked on the shoulder or fasciole area, where they are closely packed and curved forward to the suture. Aperture pyriform, the columella and outer margin strongly twisted making the short deep canal oblique. Outer margin thin, the sinus on the shoulder, deep and round. Inner margin with a narrow callus."

Measurements (mm.) —

height	width
15	6.5

Synonymy —

- 1954 *Xenuroturris corona* Laserson, The New South Wales Turridae, Handbook, Roy. Zool. Soc., N.S.W., p. 6, pl. 1, figs. 1, 2.

Types — The holotype is in the Australian Museum, Sydney.

Genus *Xenuroturris* Iredale, 1929

Type: *Pleurotoma cingulifera* Lamarck, 1822

A group of moderately large, stoutly built shells reminiscent of *Lophiotoma*, tall-spired but with a truncated base and anterior canal. Both *Lophiotoma* and *Xenuroturris* have a multispiral, axially costate protoconch but the sinus ridge in the former is concave, margined top and bottom by a raised rim, while in the latter the sinus ridge is composed of two or three linear-spaced, strong, spiral cords. Sinus deep, U-shaped, situated on the peripheral carina.

The genus *Xenuroturris* extends from the Red Sea over most of the tropical Indian Ocean and much of the tropical Pacific as far east as Hawaii.

Two groups have emerged within this vast distributional pattern and it is around the perimeter of the range that local species and subspecies have arisen. Basically there seems to have been a *cingulifera* distribution over most of the tropical Indian Ocean and a *millepunctata* distribution over much of the tropical Pacific Ocean.

The species *cingulifera* (Lamarck) was probably based upon a Mauritius shell and this location is now nominated as type locality. Shells from all western Indian Ocean localities are very uniform and do not run to large size; adults range between 35 and 40 mm.

Typical *cingulifera* appears to have spread vigorously eastward invading territory occupied by a Pacific species, *millepunctata*.

In a number of areas, New Caledonia in particular, both *cingulifera* and *millepunctata* occur together, and Miss Virginia Orr, who found both living side by side in the same ecological environment is of the opinion that they are distinct species, not varieties of a single species.

This contention is strengthened by the fact that the *millepunctata* type seems to be unknown in the Indian Ocean but is strongly represented marginally in the Pacific. It occurs with a *cingulifera* form in Japan, as an extreme southern outlier at the Kermadecs and is probably the source of one of the three distinct regional species that have developed at the Hawaiian Islands.

The situation is confused by another factor, the occurrence of a large-sized form of coarsely granular sculpture which appears to be merely an oversized *cingulifera*. This form, *legitima* Iredale, is the type of the genus, and it came from Michaelmas Cay, North Queensland. Similar shells which attain a height of over 70 mm. range from New Caledonia to Japan but nothing of comparable size is known in the Indian Ocean.

Since these large forms can occur along with typical *cingulifera* notably at New Caledonia, they seem to have no significance other than representing the optimum development of the species. In *Turris crista*, for instance, that species attains its optimum for size in the South China Sea.

Iredale separated *legitima* mainly upon the na-

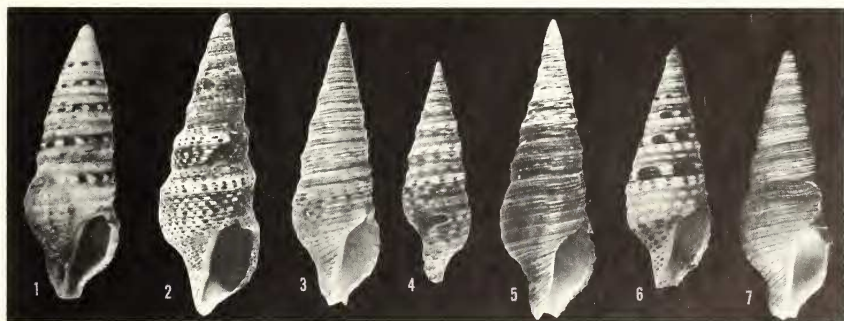


Plate 252

- Figs. 1 *Xenuroturris cingulifera erythraea* (Weinkauff). Port Sudan, Red Sea. 19 mm.
2 *Xenuroturris millepunctata* (Sowerby). Voh, New Caledonia. 35 mm.
3, 4 *Xenuroturris cerithiiformis* (Tinker). 6-8 fms., off Honolulu, Hawaii. 38.5 mm.

- 5 *Xenuroturris castanella* (Tinker). 6-8 fms., off Honolulu, Hawaii. 36.4 mm.
6 *Xenuroturris kingae* new species. 20-40 fms., off Ketchi, Hawaii. 18.3 mm.
7 *Xenuroturris incredula* (Iredale). Holotype, Port Jackson, New South Wales, Australia.

ture of the sinus ridge which was described as trilirate instead of bilirate. However, quite small examples of *cingulifera*, even from the selected type locality often exhibit this trilirate feature.

Arising out of this distributional complex the following patterns emerge: (1) typical *cingulifera* (35 to 40 mm.), Indian Ocean, infiltrated strongly into the Pacific where it attains its optimum size of about 70 mm. in Queensland, New Caledonia, the Philippines and Japan; (2) a Red Sea subspecies *erythraea* (Weinkauff); (3) two species of the *cingulifera* group at the Hawaiian Islands; (4) *mil-lepunctata*, representing an earlier Pacific distribution now broken up marginally into distinct regional species, namely, *certhiformis* in the Hawaiian Islands and *incredula* from Sydney, New South Wales.

Synonymy —

- 1929 *Xenuroturrus* Iredale, Memoirs Queensland Mus. 9(3), p. 285. Type by original designation: *X. legitima* Iredale, 1929 = *Pleurotoma cingulifera* Lamarck, 1822.
1931 *Clanurris* Iredale, Rec. Australian Mus. 18(4), p. 226. Type: *incredula* Iredale, 1931.
1960 *Xenuloturrus* (sic) Kuroda, A Catalogue Moll. Fauna Okinawa Islands, p. 37 (as a subgenus of *Turris*).

Xenuroturrus cingulifera subspecies *cingulifera* (Lamarck, 1822)

(Color pl. 175, figs. 12, 19, 20)

Range — Tropical Indian Ocean and Pacific Ocean; Japan to New Caledonia and eastward as far as the Marshall Islands and Fiji.

Description — Adult shell 40 to 70 mm. (1½ to 2¾ inches) in height. Tall-spired but with a very short anterior canal. Whorls 12, plus a multispiral, narrowly conic protoconch of 4 to 4½ whorls, brown, densely sculptured with slightly curved, strong, rounded axials crossed at right angles by weak spiral lirae. Spire tall, 20° to 24°, twice height of aperture plus canal, outlines rather straight, with sinus rib only slightly projecting. Adult sculpture consisting of a dense covering of spiral cords and threads, 4 or 5 crisp cords on the rather broad but inconspicuous subsutural fold; 2 or 3 heavier cords forming the sinus rib, situated above middle whorl height; 2 to 4 primary cords and an indefinite number of weaker spirals between the sinus area and the lower suture; and about 10 primary and many weaker spirals over the base and neck. The body whorl is subangulated at about half apertural height and strongly excavated between this and a distinct fasciole, often showing a false umbilical

chink. Sinus deep and narrow. Colour creamy-white, minutely peppered with reddish brown dots and dashes on all spirals. Stronger darker brown dashes on the component ribs of the sinus area resolved by diffusion into rather prominent regularly-spaced peripheral maculations.

Measurements (mm.) —

height	width	
72.0	23.0	"legitima," Michaelmas Cay
69.6	20.0	Philippines
62.5	19.5	Japan
58.9	16.7	Okinawa
57.0	18.0	type of <i>legitima</i>
37.7	11.0	Zanzibar

Synonymy —

- 1822 *Pleurotoma cingulifera* Lamarck, Anim. sans Vert. 7, p. 94 (no locality).
1839-40 *Pleurotoma cingulifera* Lamarck, Kiener, Coq. Viv. 5, Pleurotome, p. 17, pl. 17, fig. 1.
1843 *Pleurotoma cingulifera* Lamarck, Reeve, Conch. Icon. 1, pl. 1, sp. 1.
1884 *Pleurotoma cingulifera* Lamarck, Tryon, Manual of Conch. 6, p. 166, pl. 3, fig. 23.
1914 *Pleurotoma cingulifera flammulata* Bouge & Dautzenberg, Jour. de Conchyl. 61, p. 127 (not figured).
1929 *Xenuroturrus legitima* Iredale, Mem. Queensland Mus. 9(3), p. 285, pl. 31, figs. 3, 4.
1954 *Xenuroturrus cingulifera* Lamarck, Kira, Coloured Illustr. Shells of Japan, pl. 35, fig. 9.
1956 *Xenuroturrus cingulifera* Lamarck, Kaicher, Indo-Pacific Sea Shells, Section 5, pl. 1, fig. 1.

Types — Type locality not known. Mauritius here selected.

Records — NATAL: (A. W. B. Powell coll.); Durban and off Umkumbasa River, 40 fms. (Barnard, 1958). TANGANYIKA: Mombasa Id. (ANSP). ZANZIBAR: 1 mi. W.N.W. of Ras Mwini, 7 ft.; S. side Pwakuu Id., 11-18 fms.; outer reef, Kiwengwa, 0-10 ft.; 2 mi. W. of Nyange Id., 11 fms.; 1½ mi. W.S.W. of Ras Ngungwe, 8 fms. (NSF, 1957, ANSP). MAURITIUS: (USNM). ANDAMAN ISLANDS: (USNM); Port Blair (Winckworth coll., Brit. Mus.). SEYHELLES: Mahé (Winckworth coll., Brit. Mus.). CEYLON: 3 mi. S. of Colombo Harbour (ANSP). INDONESIA: Mosoti, Halmahera Group (USNM). CAROLINE ISLANDS: outer reef, 1 mi. S.E. of Helen Id. (NSF, 1956, ANSP); Fassera Id., Ulithi Atoll (USNM); Yap Id. (ANSP). PALAU ISLANDS: N. end of reef, Kayangel (ANSP). GUAM ISLAND: Port Merizo (ANSP); Apra Harbour, dredged (USNM); Cocos Id., S.W. of Guam Id. (ANSP). BORNEO: Taganaki Id. (USNM). DUTCH NEW GUINEA: near Hollandia (USNM). PAPUA: Yule Id. (D. Thaanum). PHILIPPINES: Salpa Id., 2 kms. S. of Olango Id.; East Cebu Id.; Calapan, Mindoro (ANSP); off N.E. Tablas, 37 fms. (USNM). MARSHALL ISLANDS: Wolpo Id., Wolpo Atoll; Kwajalein Atoll; Boek Id., Rongeriji; 1 mi. W. of Rongelap Id., 20 fms. (USNM); Ebon Id. (ANSP). JAPAN: Sagami Bay; Kii (A. W. B. Powell coll.). RYUKYU ISLANDS: (ANSP); Ohama Bay, Oisigaki Id.; off Itoyan, Okinawa, 25-40 fms. (D. Thaanum). NEW HEBRIDES: Pentecost (A. W. B. Powell coll.). NEW CALEDONIA: Plage de Poe, 1-14 ft., Bourail (ANSP). LOYALTY ISLANDS: Lifu (A. W. B. Powell coll.). FIJI ISLANDS: Namotu Id., 3-5 fms. (W. Jennings). QUEENSLAND: Michaelmas Cay (Iredale, type of *legitima*).

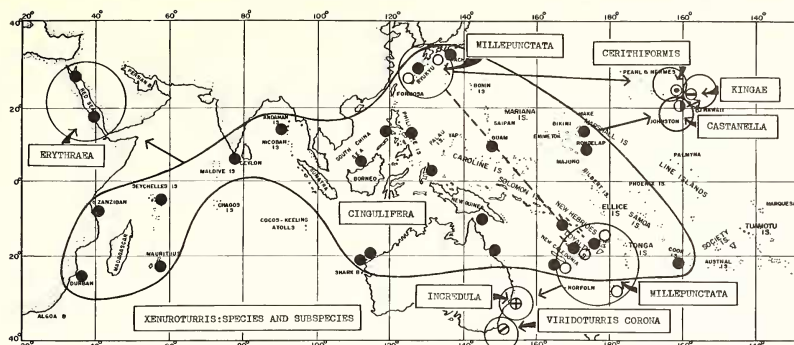


Plate 253. Geographical distribution of *Viridoturris corona* Laceron and members of the genus *Xenuroturris*.

Xenuroturris cingulifera subspecies
erythrassa (Weinkauff, 1875)

(Pl. 252, fig. 1)

Range — Red Sea.

Remarks — It is likely that the Red Sea populations may represent a good regional subspecies differing from *cingulifera* typical mainly in the much stronger and fewer spiral cords and a characteristic purple staining in adults of the anterior canal and pillar. Unfortunately, I have seen insufficient material to determine if the above mentioned characters are constant and if *cingulifera* typical is absent from the area.

Description — Adult shell 23 to 25 mm. (about 1 inch) in height. Whorls about 8, plus protoconch (missing in material examined). Spire twice the height of the aperture plus canal, angle 18° to 20° . Spire whorls with three heavy spiral keels and a fourth emergent over the latter part of the body whorl. Spiral cords on the base, 4 or 5 and strong, interspaces each with 3 or 4 crisp, spiral threads and 4 or five rounded cords on the fasciole. In two of the three specimens I have examined all the keels including the sinus one are narrowly arched but in the third specimen the sinus rib is composed, as in *cingulifera*, of two closely spaced cords. Colour pattern of small brown speckles on the primary cords and large regularly spaced, rectangular patches of dark-brown on the sinus rib, or paired dashes in one example. Pillar and anterior canal stained bright violet but this staining absent in the example with the bifid sinus rib.

Despite these variations, the Red Sea form would appear on the scant material available to represent a regional subspecies on the basis of stronger and fewer spirals and a tendency to violet staining of the anterior end.

Measurements (mm.) —

height	width	
25.0	9.0	Port Sudan
23.5	8.5	Type, Massaua
23.5	8.0	Port Sudan
19.0	7.5	Port Sudan

Synonymy —

1875 *Pleurotoma erythrassa* Weinkauff, Conch. Gab., p. 22, pl. 4, fig. 10.

1884 *Pleurotoma erythrassa* Weinkauff, Tryon, Manual of Conch. 6, p. 166, pl. 3, fig. 24.

Records — RED SEA: Massaua and Dahlack (Weinkauff) (type locality); Port Sudan (MCZ).

Fossil Records — Somali coast (Pleistocene) (Abrard, 1942, p. 86, recorded and figured as *cingulifera*).

Xenuroturris millepunctata (Sowerby, 1908)

(Color pl. 175, figs. 13, 17, 18; pl. 252)

Range — New Caledonia, Fiji, Kermadec Islands, Ryukyu Islands and Japan.

Description — Adult shell 25 to 50 mm. (1 to 2 inches) in height. Whorls 9 or 10, plus protoconch of 4 to $4\frac{1}{2}$ axially costate whorls, as in *cingulifera*. Spire about $1\frac{3}{4}$ times the height of the aperture plus canal, angle 22° to 24° . The differentiating characters from those of *cingulifera* are the colour pattern of rather sparse brown speckles, minus maculations on the sinus area, the more prominent sinus ribs and a distinct angulation of the base.

Measurements (mm.)—

height	width	
50.0	15.0	Kii, Japan
34.7	11.0	New Caledonia
25.0	9.0	New Caledonia

Synonymy —

- 1908 *Pleurotoma millepunctata* Sowerby, Proc. Malac. Soc. London 8, p. 198, text fig.
 1914 *Pleurotoma cingulifera zonifera* Bouge & Dautzenberg, Journ. de Conchyl. 61, p. 128 (not figured).

Records — JAPAN: Kii (A. W. B. Powell coll.); Ikenodan, Izu (D. Thaanum), RYUKYU ISLANDS: Gima, Kumejima Id., Okinawa (D. Thaanum). LOYALTY ISLANDS: (D. Thaanum). NEW CALEDONIA: Ile Monac (type locality); Voh, on sea-grass tidal flat, Miss V. Orr, (ANSP). KERMADec ISLANDS: Raoul Id. (W. R. B. Oliver, Australian Mus.). FIJI ISLANDS: Namotu Id., 13-15 fms. (W. Jennings).

Xenuroturris cerithiformis (Tinker, 1952)

(Color pl. 175, figs. 14, 15; pl. 252)

Range — Hawaiian Islands.

Remarks — This subspecies has long been known from distributed material bearing Dall's manuscript name, *cerithiformis*, which was quoted along with figures and a description by Tinker (1952).

Tinker did not intend to describe this and several other of Dall's manuscript species in his book, but his action does measure up to the requirements of the International Rules and amounts to formal description.

This Hawaiian species is close to *millepunctata* but differs consistently in having more rounded whorls, neither sharply angled on the base nor deeply excavated at the neck.

Description — Adult shell 33 to 53 mm. (1¼ to 2 inches) in height, whorls 10 or 11, plus a multi-spiral narrowly conic protoconch of 4 to 4½ whorls, brown, densely sculptured with slightly curved strong rounded axials crossed at right angles by weak spiral lirae. Spire tall, almost twice the height of the aperture plus canal, 24° to 27°, outlines lightly convex except for bulging subsutural fold and sinus rib. Sculpture of spire whorls consisting of a broadly-convex subsutural fold bearing 3 to 5 weak spiral threads, separated by a narrow deeply channelled concavity from the sinus rib, situated at about middle whorl height and composed of two moderately strong, rounded, spiral cords with a concavity between. Below the sinus area there are 2 to 4 crisp cords of varying strength. About 10 primary cords and occasional interstitial threads on the base from below the sinus area plus 4 cords

on the weak fasciole. Sinus deep and narrow. Colour white, rather evenly speckled with reddish brown dots and dashes; larger maculations not present.

Measurements (mm.)—

height	width	
53.0	18.0	Pearl and Hermes Reefs, Hawaii
45.0	14.5	Kalaekiki, Hawaii
38.5	11.4	Honolulu, 6-8 fms. (type)
33.4	11.0	Honolulu, 6-8 fms.
32.0	10.2	Honolulu, 6-8 fms.

Types — I hereby select the specimen in USNM 338601 as the holotype. It is figured in our plate 175, fig. 14. The type locality, here designated, is 8-10 fms., entrance to Honolulu Harbor, Oahu Id., Hawaii.

Synonymy —

- 1869 *Pleurotoma lirata* Pease, Amer. Jour. Conch., Philadelphia, 3, p. 68 (non *Pl. lirata* Reeve, 1845).
 1952 *Turris cerithiformis* (Dall, ms.) Tinker, Pacific Sea Shells, Honolulu, p. 46, pl. 47, fig. (upper row).

Records — HAWAIIAN ISLANDS: entrance to Honolulu Harbour, 6-8 fms., Oahu (holotype, USNM) (D. Thaanum coll.). (ANSP): off Fort Armstrong, Honolulu, 15-20 ft. (ANSP); Ka Lae Kiki Koloa, Kauai (ANSP); Pearl and Hermes Reef, Hawaii (ANSP); off Kaanapali, West Maui, 25-75 ft.; Keaukaha Ponds, Hawaii; off Kewalo, Oahu, 20 fms. (D. Thaanum coll.).

Xenuroturris castanella (Tinker, 1952)

(Color pl. 175, figs. 21, 22; pl. 252)

Range — Hawaiian Islands.

Remarks — Again this species has long been known from distributed material bearing Dall's manuscript name. (See remarks concerning Tinker's use of Dall's manuscript names, above.)

This is a member of the *cingulifera* series but an endemic Hawaiian one sufficiently distinct in its sculpture and coloration to warrant full specific status.

Description — Adult shell, 35 to 45 mm. (1¼ to 1½ inches) in height. Whorls about 10, plus a multi-spiral, narrowly conic protoconch of 4 to 4½ whorls, brown, densely sculptured with slightly curved, strong, rounded axials crossed at right angles by weak spiral lirae. Spire tall, 1½ to 1¾ times the height of the aperture plus canal, 22° to 24°, outlines lightly convex. Sculpture of spire whorls of closely spaced, rather evenly developed, moderately strong but narrow, crisp, spiral cords. Three cords on a slightly raised subsutural fold, 3 forming the sinus rib, situated above middle of whorl height and 2 primary cords with 3 threads in each inter-

space from below the sinus rib to the lower suture. On the base, from the sinus area to the fasciole, there are 7 to 9 primary cords with a varying small number of secondary cords or threads in the interspaces; 5 spiral cords on the fasciole. Sinus deep and narrow. Colour chestnut-brown with the primary cords slightly darker. Faint traces of regular rectangular darker-brown maculations on the sinus rib. Parietal callus, columella and interior of aperture white.

Measurements (mm.)—

height	width	
44.0	12.7	Honolulu, 6-8 fms.
39.0	12.0	Honolulu, 6-8 fms.
36.4	11.7	Honolulu, 6-8 fms. (holotype)

Types—I hereby select as holotype the specimen in USNM no. 338610, which is figured on our pl. 175, fig. 21. The type locality, here designated, is 6-8 fms., entrance to Honolulu Harbor, Oahu Id., Hawaii.

Synonymy—

1952 *Turris castanella* (Dall ms.) Tinker, Pacific Sea Shells, Honolulu, p. 46, pl. 47, fig. (middle row, right).

Records—HAWAIIAN ISLANDS: Honolulu Harbour entrance, 6-8 fms. (D. Thaanum) (USNM, holotype), (ANSP); off Kaanapali, West Maui, 25-75 ft.; off Launiupoko Camp, West Maui, 25-75 ft. (D. Thaanum).

Xenuroturris kingae new species

(Pl. 252, fig. 6)

Range—Hawaiian Islands.

Remarks—This handsome little shell belongs to the *cingulifera* series. It is easily distinguished by the almost complete absence of secondary spiral sculpture and by the heavy, rectangular, dark-brown maculations which are on the subsutural fold, not on the peripheral sinus rib, as in *cingulifera*. This species is named for Mrs. M. E. King of Honolulu who generously made available the turrids from her "Pele II" dredgings.

Description—Adult shell 15 to 18 mm. (about $\frac{3}{8}$ inch) in height. Whorls 6 $\frac{1}{2}$ to 7 plus a tall, narrowly conic, dark-brown protoconch of 4 $\frac{1}{2}$ whorls, sculptured with closely spaced regular axials. Sculpture of spire whorls consisting of a heavy subsutural fold bearing 2 smooth spiral cords, followed by a heavy projecting sinus rib, margined top and bottom by smooth rounded cords. Below this is a weaker spiral cord with a second emergent over the last whorl. Six smooth cords below the level of the top of the aperture and a further four closely-spaced cords on the weak anterior fasciole. Inter-

stices of all the spiral cords smooth, except for an occasional thread. Sinus a deep narrow square-cut slit. Colour creamy white with a spiral series of large dark red-brown rectangular maculations on the subsutural fold and a tessellation of spots on all the other spiral cords, those on the base and fasciole dark reddish brown, the rest light-brown.

Measurements (mm.)—

height	width	
18.2	6.4	holotype
15.5	5.4	

Types—The type locality is 20 to 40 fms. on fine sand, off Keelii, Oahu Id., Hawaii. Collected by Mrs. M. E. King on Mar. 1, 1962, on the "Pele II." The holotype is in the B.P. Bishop Museum in Honolulu.

Records—HAWAIIAN ISLANDS: Oahu Id., 20-40 fms. on fine sand (Mrs. M. King, "Pele II." Mar. 1, 1962, holotype); Mokolua Rock, Kaibua Bay, 10 fms. (C. Weaver, Nov., 1962); Oahu, off Waikiki, dredged (D. Thaanum).

Xenuroturris incredula (Iredale, 1931)

(Pl. 252, fig. 7)

Range—A single imperfect specimen from deep dredging of the sea bed in Port Jackson, Sydney, Australia (type locality).

Remarks—This species was introduced as the type of a new genus, *Clamturris* Iredale, 1931, but since the apical whorls are unknown there is no reason at present for separating the species from *Xenuroturris*. Specifically it is distinct from *cingulifera* in its sculptural detail of numerous plain spirals, none of which are nodular, the rather ill-defined peripheral sinus rib and the uniformly rich reddish brown colour. The only other species of similar coloration is *castanella* (Tinker) from Hawaii.

Until more material is available this species cannot be properly evaluated. Lasearon (1954, p. 7) pointed out that the unique specimen may be from a subrecent deposit and possibly now extinct.

Measurements (mm.)—

height	width
60	21

Synonymy—

- 1931 *Clamturris incredula* Iredale, Rec. Australian Mus. 18(4), p. 226, pl. 25, fig. 21.
1954 *Clamturris incredula* Iredale, Lasearon, The New South Wales Turridae, Handbook, Roy. Zool. Soc., N.S.W., p. 7, pl. 1, fig. 10.

Types—The holotype is in the Australian Museum, Sydney.

[These occasional blank areas occur between genera and subgenera to permit the insertion of new material and future sections in their proper systematic sequence.]

Genus *Turris* Röding, 1798

Type: *Murex babylonius* Linné, 1758

This is a genus of large-sized shells of 100 to 140 mm., of narrowly fusiform shape with tall spire and having a long anterior canal. Sinus deep and narrow, situated, typically, on a special rib above the peripheral carina. Protoconch paucispiral, small, blunt, globular, of $1\frac{1}{2}$ to 2 smooth whorls. Operculum leaf-shaped with apical nucleus. Radula, $1+0+0+0+1$, marginals only which are "wish-bone"-shaped.

The genus is widespread in the tropical Indo-Pacific and is known fossil, with certainty, from the Pliocene of Karikal, Southern India, and probably includes a series of Australian Miocene species that stand nearer to *Turris* than to *Lophioturris*. The genus name, *Turris*, is feminine.

Synonymy —

- [1766 *Turris* Müller, Delic. Natur. Selectae, Munich, pt. 1, p. 129. Type: *Turris Babylonica* Rumphius, A non-binomial work].
 1798 *Turris* Röding, Museum Boltenianum, Hamburg, pt. 2, p. 123. Type by Dall's subsequent designation (1909, U. S. Geol. Survey Prof. Paper 59, p. 24): *Murex babylonus* Gmelin [sic] = *Murex babylonius* Linné, 1758.
 1799 *Pleurotoma* Lamarck, "Prodrome," Mem. Soc. d'Hist. Nat. de Paris I, p. 73, no. 26. Type by monotypy: *Murex babylonius* Lin.

- 1810 *Pleurotoma* Montfort, Conchyl. Systém., Paris 2, p. 535. Type by monotypy: *Murex babylonius* Linn.
 1834 *Pleurostoma* (Gray ms.) Griffith and Pidgeon, Cuvier's Animal Kingdom, Moll. 12, p. 599. Error for *Pleurotoma* Lamarck, 1799. Non Roemer, 1840, a sponge.

Turris babylonica (Linnaeus, 1758)

(Color pl. 181, figs. 1-6)

Range — Philippines and Indonesia to the Solomon Islands, Melanesia.

Remarks — Some rather distinct forms of this species occur, but since the material available to me is scant, and, further, since these variants upon the available evidence do not seem to relate exclusively to geographical areas, it is not possible to judge if the several forms have arisen in response to ecological conditions, segregation, or are accountable just as variation within acceptable specific limits.

Typical form — As described below, with a spire angle of 29° to 32° . Most records of this form come from the vicinity of the Philippines but it spreads westward through Indonesia and south eastward to the Solomons.

Narrow form — This is identical with the typical form in rib development and in colour pattern but is a much more slender shell with a spire angle of from 22° to 25° . It is a common form in the Philippines but indications are that the two forms do not occur in one breeding colony which suggests that the differences are ecologic. By the form of the subsutural cord, shown in his illustration, Tapparaone-Canefri's *Pleurotoma raffrayi* would appear to

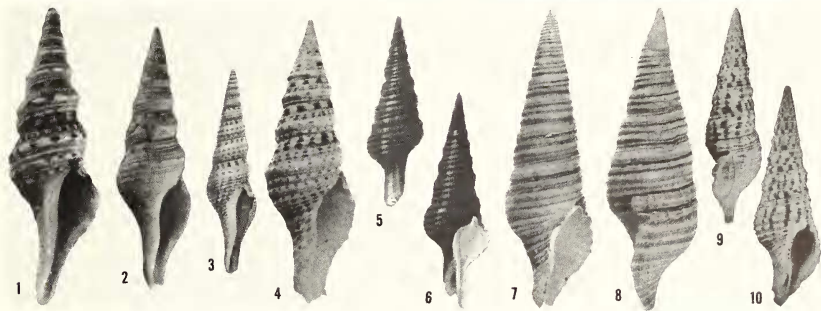


Plate 254

- Figs. 1 *Turris garmonsii* (Reeve). Holotype, Cebu Id., Philippines. 47.5 mm.
 2 *Turris crisa variegata* (Kiener). Madras, India. 63.5 mm.
 3 *Turris crisa yeddoensis* (Jousseaume). Japan (from Jousseaume, 1883, pl. 10, fig. 7).
 4 *Turris crisa intricata* new subspecies. Holotype. 12 fms., off Honolulu, Hawaii. 44 mm.

- 5, 6 *Turris annulata* (Reeve). Original figs. of *Pleurotoma fagina* Adams and Reeve, 1850, from the "China Sea."
 7, 8 *Turris anicta* (E. A. Smith). Bombay, India. 46 mm.
 9, 10 *Turris undosa* (Lamarck). Philippines. 88.2 mm.

be a synonym of the narrow form of *babylonica*, rather than a synonym of *garmonsii*, as claimed by Tryon, 1884, p. 163.

Sparsely pale-spotted form—This form has all the shell features of the typical form but has a more sparse colour pattern in dark- and pale-brown, resembling that of *garmonsii*. The dark-brown maculations are restricted to the subsutural cord and the basal cords but all those associated with the sinus cord, the peripheral cord and the one beneath it are pale-brown. This form is known to me only from the Geelvink Bay area, Dutch New Guinea, but the typical form occurs in that area also. Field records for the Geelvink Bay area indicate that both the typical and the pale form occur in shallow water on fine coral sand, down to a depth of at least twenty feet.

Description—Adult shell 75 to 85 mm. (about 3 inches) in height, solid, elongate-fusiform, rather smooth and shining white, with a bold pattern of clear-cut black spots and rectangular maculations. Sculpture prominent, of broad rounded spiral ribs with intermediate narrow cords. On the spire whorls there is a broad massive subsutural fold-like rib, weakly carinate in the middle and margined both above and below by a thin sharp cord. Between this and the sinus rib there is a rather stronger narrow sharply raised cord. Sinus rib narrow, flat, slightly bevelled along its upper margin. Another sharp narrow cord separates the sinus rib from the broad massive fold-like peripheral spiral which is weakly carinate also, and by its prominence imparts a distinct angulation to the whorls. Below this, on the base and anterior canal, there is an alternation of moderately strong carinate primary ribs and narrow sharply raised secondary cords. Below the periphery on the last whorl there are 7 or 8 primary ribs and one or two narrow cords in each interspace. On the spire whorls only one secondary cord and part of one primary rib appear between the peripheral cord and the lower suture. Aperture plus canal, which is moderately long, about three-fourths the height of the spire. The maculations occur only upon the primary cords and on the sinus rib; they are large and squarish on the subsutural fold, tending to be smaller and more rounded on the other cords and as a series of dashes on the sinus rib.

Measurements (mm.)—

height	width	
82.0	18	Philippines (narrow form)
79.0	20	Jagoliao Id., Philippines

75.5	21.7	Philippines
66.0	17	Abroeki Id., Dutch New Guinea
58.2	16	Bismarck Archipelago.

Synonymy—

- 1758 *Murex babylonius* Linnaeus, Systema Naturae, ed. 10, p. 753. Based upon Lister, Conch., pl. 917, fig. 11; Rumphius Mus., pl. 29, fig. 1; Gualteri, pl. 52, fig. N.N.; Argenville Conch., pl. 12, fig. M.
 1791 *Murex babylonius* Linn., Gmelin, Systema Naturae 11(6), p. 3541, sp. 52. Based upon Lister, Rumphius, Gualteri, Argenville, etc.
 1798 *Turris babylonica* Röding, Museum Boltenianum, Hamburg 2, p. 123. Based upon *Murex babylonius* Gmelin, sp. 52 and Martini, 4, pl. 143, figs. 1331, 1332.
 1816 *Pleurotoma babylonica* Linn., Lamarck, Encycl. Meth., pl. 439, figs. la, b. Liste, p. 8.
 1817 *Murex babylonius* Linn., Dillwyn, Desc. Cat. Recent Shells, London 2, p. 714, sp. 66.
 1839-40 *Pleurotoma babylonica* Linn., Kiener, Coquilles Vivantes 5, Pleurotome, p. 4, pl. 1, fig. 1, but not fig. 2.
 1843 *Pleurotoma babylonica* Linn., Reeve, Conch. Iconica 1, pl. 1, sp. 5.
 1843 *Pleurotoma venusta* Reeve, Conch. Iconica 1, pl. 9, sp. 79 (has all the characters of typical *babylonica* but not fully grown; 54.5 × 18 mm.)
 1878 *Pleurotoma raffrayi* Tapparone-Canevari, Bull. Soc. Zool. France 3, p. 246, pl. 6, fig. 1 (Port Dorey, New Guinea).
 1884 *Pleurotoma babylonica* Linn., Tryon, Manual of Conch. 6, p. 162 (in part, exclusive of *spectabilis*), pl. 1, fig. 1.
 1956 *Turris babylonius* Linn., Kaicher, Indo-Pacific Sea Shells, Section 5, Toxoglossa, pl. 1, fig. 6.

Types—The holotype of *venusta* Reeve from Siquijor Island, Philippines, is in the British Museum (Natural History) in London.

Records (Typical form)—PHILIPPINES: Siquijor Id. (type locality of *venusta*); Calapan, Mindoro Id.; Masingin, Jetafe, Bohol Id.; Bongao Channel, S.W. end of Sangha Sangha Id., Sulu Arch.; Balabac Id., Palawan; Jagoliao Id., N.W. end of Bohol Id. (duPont-Acad. Exped., 1958, ANSP). CELEBES: Buton Strait, Gr. Tobea Id. (USNM). DUTCH NEW GUINEA: islands 2 mi. N.W. of Soweik, Soepiori, Schouten Ids., sand and rock; Cape Tekopi, W. side Samberbaba, Japen Id.; island off N.E. tip of Ambai, Japen Id., 10-15 ft., sand and grass (NSF, 1956, ANSP). ADMIRALTY ISLANDS: Koruniat Id. (ANSP). BISMARCK ARCHIPELAGO: Umhoi Id., Siassi Ids. (MCZ). SOLOMON ISLANDS: Pavavu Id.; Russell Id. (USNM); Ata District, Malaita (ANSP).

(*Narrow form*)—PHILIPPINES: Calatagan, Batangas, Luzon Id.; E. side of Jagoliao Id., N.W. end of Bohol Id., 12-24 ft. (duPont-Acad. Exped., 1958, ANSP).

(*Sparsely spotted form*)—DUTCH NEW GUINEA: shore reefs, 5 mi. N.W. of Rani Id., Biak Id., Schouten Ids.; N. shore of Matas Id., Aorei Ids., Geelvink Bay; Abroeki Isle, Maransabadi Id., Aorei Ids.; Sakfondoe Id., 1½ mi. W. of



Plate 255. Nuclear whorls of *Turris crispa yeddoensis* (Jousseaume), Japan.

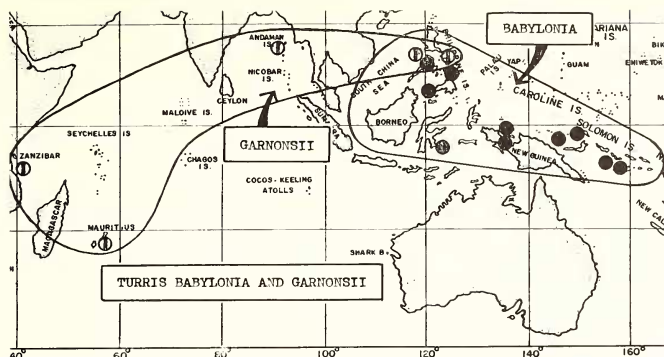


Plate 256. Geographical distribution of *Turris babylonia* (Linnaeus) and *Turris garnonsii* (Reeve).

Sowek, Soepiori, Schouten Ids., dredged, sand and grass; S.W. side of Maransabadi, Aoei Ids., 10-20 ft., sand; N. side of Matas Id., Aoei Ids., 2-4 ft., fine sand and grass; ¼ mi. S.W. of Pai Isle, Mios Woendi Atoll, Padaido Ids., dredged, 12-16 ft., sand (NSF, 1956, ANSP).

Turris garnonsii (Reeve, 1843)

(Color pl. 181, figs. 7, 8, 18; pl. 254)

Range — Western Indian Ocean, eastward to the Philippines. Pleistocene, Somali coast and upper Tertiary, British North Borneo.

Remarks — The shell of *garnonsii* is more slender than that of *babylonia* and has a much weaker angulation. The sculpture, although basically similar to that of *babylonia*, consists of narrower but more strongly carinate cords and the whole surface, including the cords, is crossed by dense lamellate axial threads. The subsutural fold is low in profile but is carinated at the middle by a sharply-raised, strong, spiral thread and margined both above and below by a weaker but distinct thread. Between this and the sinus rib there are one or two sharply-raised, spiral threads. Sinus rib narrow, flat, its top margin projecting a trifle more than the lower margin. The peripheral cord is sharply carinate but only slightly stronger than the other cords and thus forms only a weak angulation of the whorl outline. There are two primary carinate cords below the angulation, the uppermost of which is emergent at the suture. One or two crisp narrow threads between each pair of primaries. Below the lowest primary there are 14 to 16 subequal crisp narrow threads extending down to the weak fasciole.

Although typical *garnonsii* is found in many museum and private collections with the locality "Zebu," it is doubtful if the data is correct in all cases since it was common practice with dealers to cite a published locality when the actual source of a specimen was unknown. The distributional centre of *garnonsii* is the western Indian Ocean and it becomes uncommon and of sporadic occurrence to the east where it is in competition with *babylonia*.

A very slender form of this species occurs in the Philippines but insufficient material is available to decide its status. See Plate 181, fig. 18, one of two such specimens in the Museum of Comparative Zoölogy, Harvard. Weinkauf (1875, Conch. Cab., pl. 2, figs. 3, 4) figured a similar specimen, also from the Philippines.

Description — Adult shell 58 to 75 mm. (2¼ to 3 inches) in height, of rather light build, elongate-fusiform, with whorls only slightly angulate. Spire angle 20° to 23°. Colour pattern of chestnut-brown oblong maculations chequering the subsutural fold and a more or less coalescent band of similar colour encircling the base below the level of the aperture. Sinus rib with closely-spaced dots; remaining cords with irregularly-disposed small dots. Ground colour ivory-white. The species replaces *babylonia* over the western tropical Indian Ocean.

Measurements (mm.) —

height	width	
74.0	17.2	Zanzibar
71.0	19.0	"Philippines" (ex Sowerby)
67.0	17.0	Zanzibar, 12-14 fms.
56.0	13.4	Zanzibar
47.5	13.7	Cebu Id., Philippines (holotype)

Synonymy —

1839-40 *Pleurotoma babylonia* var., Kiener, Coq. Viv. 5, Pleurotome, pl. 1, fig. 2.

however, in the subsutural fold which is composed of two primary cords only, and the lack of distinct angulation of the whorls. Spire angle 21° to 22° . Anterior canal plus aperture almost equal to the height of the spire. Colour pattern of the young shell consisting of narrow flexuous dark-brown lines forming an overall haphazard vertically flowing pattern. In adult shells the maculations tend to widen into dashes, thus destroying the vertical flowing pattern.

Measurements (mm.)—

height	width	
156.0	31.0	"Indian and Chinese Seas" (Brit. Mus.)
140.0	26.5	type of <i>grandis</i> , G. and P.
137.0	27.0	Philippines (AMNH)
130.0	26.5	Hong Kong (USNM)
124.0	24.0	Hong Kong (ANSP)
87.0	19.5	Albay Prov., Philippines (ANSP)
61.5	14.0	Noumea, New Caledonia (ANSP)

Synonymy—

- 1816 *Pleurotoma crisa* Lamarck, Encycl. Meth., pl. 439, fig. 4. Le Liste, p. 8.
 1834 *Pleurotoma grandis* (Gray ms.) Griffith and Pidgeon, Cuvier's Animal Kingdom 12, Mollusca, p. 599, pl. 23, fig. 1.
 1843 *Pleurotoma crisa* Lamarck, Reeve, Conch. Icon. 1, pl. 2, fig. 11.
 1843 *Pleurotoma grandis* Gray, Reeve, Conch. Icon. 1, pl. 2, fig. 13.
 1875 *Pleurotoma gracillima* Weinkauff, Conch. Cab. 4(3), p. 26, pl. 5, figs. 4, 5.
 1884 *Pleurotoma grandis* Gray, Tryon, Manual of Conch. 6, p. 163, pl. 1, figs. 6, 7.
 1922 *Turris crisa* Lamarck, Hedley, Rec. Australian Mus. 13(6), p. 215.
 1956 *Turris crisa* Lamarck, Kaicher, Indo-Pacific Sea Shells, Section 5, Toxoglossa, pl. 1, fig. 7.
 1959 *Turris crisa* Lamarck, Kira, Coloured Illustr. Shells of Japan (ed. 2), p. 71, pl. 35, fig. 5.

Types—The holotype of *grandis* "Gray" G. and P., is in the British Museum (Natural History) in London.

Records—MADAGASCAR: 3 mi. N.N.E. of Nossi Fahi, E. of Nossi Bé, 9 fms.; Andilana and Nosi Antsaibory, N.W. Nossi Bé, 0-5 ft. (ANSP). ANDAMAN ISLANDS: Port Blair (Winckworth coll., Brit. Mus.). THAILAND: Ko Pluket (F. N. Crider). HONG KONG: (USNM); $20^{\circ} 15' N$, $112^{\circ} 36' E$, 50 fms. (F.R.V. "Alister Hardy," ANSP). PHILIPPINES: Tabaco, Albay Province, E. side Luzon Id. (duPont-Acad. Exped., ANSP); Cebu (USNM); Batangas Bay, Luzon Id. (MCZ). AUSTRALIA: Queensland: Darnley Id., 20 fms.; Mapoon, Gulf of Carpentaria, 10 fms., (Australian Mus.); traveled off Townsville (Mrs. J. Kerslake); Western Australia: Onslow (Mrs. J. Kerslake); W. of Flat Id., near Onslow, 6-10 fms.; off Legendre Id., Dampier Archipelago, 23 fms.; between Malus and Gidley Id., Dampier Archipelago, 10-14 fms.; 10 mi. W. of Bernier Id. (W. Austr.-Hawaiian Exped., 1960). NEW CALEDONIA: mouth of stream, Anse Vata Bay, Noumea, 2-6 ft., sand and rocks; Baie de Citron, Noumea, 1-6 ft., rocks, sand and silt (ANSP). FIJI: Vunivundra Id., 4-5 fms.; Akuilau Id., 3-4 ft. at low tide (W. Jennings, 1961-62).

Fossil Records—Recorded from the Pliocene of Karikal, Southern India (Cossman, 1900, p. 17) but since the writer has not seen this material it is uncertain whether Cossman's specimens were *crisa crisa* or *crisa variegata*.

Turris crisa subspecies yeddoensis (Jousseaume, 1883)

(Color pl. 181, fig. 13; pl. 254, fig. 3)

Range—Japan and the Ryukyu Islands.

Remarks—All the Japanese forms of *crisa* the writer has seen are rather uniform and seem to represent a regional subspecies for which Jousseaume provided a name.

A specimen in the British Museum (Winckworth coll.) has a "foreign" operculum affixed. It is of the medio-lateral nucleus type as in *Turricula javana* (Linnaeus); the operculum in all species of *Turris* is leaf-shaped with an apical nucleus.

Description—Shell characterized by finer and more uniform development of the spiral ribbing, especially over the base. The peripheral spiral cord is no heavier than the rest, and the colour pattern consists of relatively sparse to crowded dots and dashes on all the spiral cords. Only rarely does the pattern resolve into larger subsutural maculations and all examples lack the vertical, flexuous, narrow, dark lines so characteristic of the younger stages of *crisa*. Height 60 to 82 mm. ($2\frac{1}{2}$ to $3\frac{1}{4}$ inches). Spire angle 23° , spire greater than height of aperture plus canal. Protoconch paucispiral, smooth, of two whorls, with a blunt dome-shaped apex. The subspecies appears never to attain the size of typical *crisa*.

Measurements (mm.)—

height	width	
82.0	22.0	Japan, Enoshima (British Mus.)
82.0	18.5	Japan
70.0	15.3	Okinawa
67.2	15.7	Japan

Synonymy—

- 1883 *Pleurotoma yeddoensis* Jousseaume, Bull. Soc. Zool. France 8, p. 196, pl. 10, fig. 7 (Japan).
 1884 *Pleurotoma yeddoensis* Jousseaume, Tryon, Manual of Conch. 6, p. 319, pl. 34, fig. 7.
 1951 *Turris crisa* Lamarck, Hirase and Taki, Handb. Illustr. Shells, revised ed. of "A Collection of Japanese Shells," pl. 115, fig. 1.

Types—The type locality is "Japan." The type is probably in the Paris Museum.

Records—JAPAN: Tanabe (D. Thaanum coll.); Enoshima (Brit. Mus.); off Tanabe, 30 fms. (Powell coll.); Wakanura; Kishiu and Kii (USNM). OKINAWA: off Ito-man (D. Thaanum coll.).

***Turris crispa* subspecies
variegata (Kiener, 1839)**

(Pl. 254, fig. 2)

Range — Indian Ocean, probably restricted to the west coast of India.

Remarks — For the present this shell is admitted as a subspecies of *crispa*. Very few specimens are available and nowhere has the writer seen a series from any one locality. These odd occurrences could be individual variants exhibiting a shorter, slightly twisted canal and a somewhat pagodiform spire, due to more prominence of the peripheral angle. On the other hand, the few examples seen are all from Madras and vicinity and true *crispa* seems to be absent from that area.

This may reasonably be considered an Indian regional subspecies of *crispa* comparable with two other subspecies occupying areas marginal to the *crispa* typical range, i.e., *yeddoensis* Jousseaume from Japan and *intricata* n. subsp. from Hawaiian Islands.

Description — Adult shell about 57 to 64 mm. (2½ to 2½ inches) in height. Whorls 12+ (protoconch missing). Spire 1.2 times the height of the aperture plus canal; spire angle 24° to 25°. Anterior end relatively short and slightly flexed. Sculpture of the spire's whorls consisting of a subsutural pair of spiral cords, followed by 2 to 4 spiral threads in the concave interspace preceding the sinus rib which is concave, margined both above and below by a narrow sharply raised cord. Next comes the prominent, broad, but narrowly arched peripheral carina. Below this is an alternation of closely spaced smooth primary and secondary cords. The relatively prominent peripheral carina is just below middle whorl height and gives a pagodiform outline to the spire. Surface somewhat worn in all examples seen but there is evidence of dense axial lamellate threads as in the typical species. Colour creamy white, finely speckled with light-brown, not connected vertically in a flowing pattern as in the typical subspecies; some larger maculations on the subsutural fold and in one example (Madras) a spiral zone of light-brown encircles the base.

Measurements (mm.) —

height	width	
82.5	22.0	"Cebu," correct?
63.5	17.0	Madras (Brit. Mus.)
59.0	15.5	Tuticorin, 9 fms. (Brit. Mus.)
57.0	15.0	Madras (A. W. B. Powell coll.)

Synonymy —

1839-40 *Pleurotoma variegata* Kiener, Coq. Viv. 5, Pleurotome, pl. 9, fig. 1.

?1843 *Pleurotoma variegata* Kiener, Reeve, Conch, Icon. 1, pl. 1, fig. 2.

Records — INDIAN OCEAN (type locality): INDIA: Madras; Tuticorin, 9 fms. (Brit. Mus., Winckworth coll.). A large example from the McAndrew collection in the British Museum belongs here but the locality "Zebu" = Cebu, is doubtful. Along with it is a small specimen of *garmonsii*.

***Turris crispa* subspecies
intricata new subspecies**

(Pl. 254, fig. 4)

Range — Hawaiian Islands.

Remarks — This is a Hawaiian subspecies in the *crispa* complex which is characterized by its small size, the prominence of the peripheral carina, the truncated and twisted anterior end, and the speckled pattern which is not connected by flexuous axial colour lines. The Japanese *yeddoensis* differs mainly in the more even development of the spiral cords, the sinus rib being more prominent than the peripheral one below it.

Description — Adult shell about 44 mm. (1½ inches) in height, solid, fusiform and prominently keeled at lower third of whorl height. Whorls 11+ (protoconch missing). Spire 1.2 times the height of the aperture plus canal; spire angle 27°. Anterior end relatively short and slightly flexed. Sculpture of spire's whorls consisting of a subsutural pair of spiral cords followed by the concave sinus rib which is margined top and bottom by a smooth rounded cord. Next comes the massive peripheral carina which is narrowly arched and is margined both above and below by spiral threads. Below the periphery there is one primary cord and a second one half emergent at the lower suture. On the body whorl, base and fasciole, from below the peripheral carina, there are 16 primary spiral cords, the upper 3 with a single thread in each interspace. The whole surface is crowded with relatively strong lamellate axial growth lines. The sinus is deep and situated on a ridge above the peripheral carina. Colour creamy-white, speckled with dots and dashes, confined to the spiral cords and threads. There are no connecting axial colour lines and streaks as in the younger forms of *crispa*. On the two subsutural cords and on three consecutive cords on the upper part of the base, the maculations consist of more closely-spaced dashes which imparts a slightly banded appearance to the shell.

Measurements (mm.)—

height	width	
44.0	13.5	holotype
34.0	10.0	off Maui
27.0	8.5	off Waikiki

Types—The holotype is in the United States National Museum, Washington. The type locality is 12 fms. entrance to Honolulu Harbor, Oahu Id., Hawaii. USNM no. 338617.

Records—HAWAIIAN ISLANDS: entrance to Honolulu Harbor, 12 fms. (holotype); off Kaanapali, 4-12 fms., (USNM); West Maui, off Launiupoko Camp (D. Thaanum coll.); off Kewalo, 20-30 fms. (Mrs. M. King, "Pele II," Apr. 23, 1962).

Turris annulata (Reeve, 1843)

(Color pl. 181, fig. 19; pl. 254)

Range—Persian Gulf to Japan, and Pliocene of Java and Timor, Indonesia.

Remarks—This species name has often been misapplied to a South India shell which should bear the name of *Turris amicta* (E. A. Smith, 1877). Uncertainty regarding the true identity of *annulata* was due to the fact that Reeve's type specimen has long been missing from the British Museum collection.

Reeve's figure is not very detailed and his description, as follows, is very brief: "Shell solid, subulate, brown; whorls slightly convex, encircled with a number of smooth paler ridges, like rings; canal rather long."

However, the writer found a small specimen in the Tomlin collection at the Welsh National Museum, Cardiff, which is almost certainly the missing type of *annulata*. This specimen matches Reeve's figure very well for size, coloration and general appearance. It is brown, with the sinus rib paler, the operculum is leaf-shaped with an apical nucleus and the shell measures 49.5×14 mm. It is labelled *Pleurotoma annulata* but has no locality data.

Without doubt *Pleurotoma fagina* Adams and Reeve, 1850, from China Seas is a synonym of *annulata*. The type specimen of *fagina* differs from that of *annulata* only in being fully adult and in exhibiting two pathological features, a more deeply excavated base, the result of an early injury to the shell, and a twisted pillar with an associated false umbilical chink. The twisted pillar signifies a gerontic condition also found occasionally in *babylonia* and normally in *cryptorrhaphae*.

Very few examples of *annulata* are available. The presumed type is an immature shell but there is an adult unlocalised shell in the Powell collection, the

type of *fagina* is adult but gerontic and abnormal, due to injury, and deep-water shells from off Japan, presumed to be this species differ in their pale coloration. It is likely that when more material is available the Japanese deep-water form may prove to be subspecifically distinct.

Descriptions follow of (a) the typical brown form, which is probably shallow water, and (b) the light-coloured form from deep water off Japan.

Tryon's figure of *annulata* (1884, pl. 6, fig. 83), a copy of Reeve's fig. 35, is misleading in that the sinus rib appears gemmate, which is not the case, nor is it in accord with the original figure.

Description (a) Typical form—Shell 64 to 74 mm. ($2\frac{1}{2}$ to 3 inches) in height; whorls lightly convex; spire tall, 1.3 times the height of the aperture plus canal, angle 24° to 25° , sculptured with heavy rounded spiral ridges, separated by deep narrow interspaces, one, rarely two spiral threads in each interspace. The spiral ridges are rather smooth and angulate at the crest, except for the sinus ridge, which is biangulate. On the spire the spiral ridges number three, with a fourth emergent toward the aperture. Spirals diminish rapidly in strength over the lower base and pillar. Sinus of moderate depth, on the biangulate ridge which is situated slightly above middle whorl height. Colour uniform reddish brown, interior of aperture and parietal wall white. Described from a specimen of unknown locality (Powell coll.).

Description (b) White deep-water form—Shell up to 77 mm. (3 inches) in height, whorls lightly convex, spire tall, 26° , sculptured with heavy, rounded, spiral ridges separated by deep narrow interspaces, with one (rarely two) crisp spiral threads in each interspace. On the early whorls there are 3 spiral ridges, and these increase to 4 from the antepenultimate onward. On the base and neck there are a further 15 primary ridges, the two uppermost stronger than those following. In detail, the sculpture on the later whorls of the spire is as follows: subsutural ridge or fold consisting of a closely spaced pair of spiral cords, the next, which is the sinus rib, consists of two fused cords, followed by numbers three and four, each of which consists of a heavy cord fused to a narrow one immediately below. On the body whorl, number three spiral is clearly shown as peripheral. The whole surface is crossed by dense thread-like axial growth lines. Aperture relatively narrow, ovate, with a moderately long straight canal. Spire 1.3 times the height of aperture plus canal. Colour dull white in general

but tinted pale yellowish brown in the rib interstices of the spire's whorls. Described from a specimen from 50 fathoms off Tosa, Japan (ANSP).

Measurements (mm.)—

height	width	
77.0	20.0	Tosa, Japan
73.5	21.0	holotype (<i>fagina</i> Adams and Reeve)
49.5	14.0	holotype? (<i>annulata</i> Reeve)
46.5	15.1	Bombay, India
39.5	11.0	Henjam, Persian Gulf, 46 fms.

Synonymy—

- 1843 *Pleurotoma annulata* Reeve, *Conch, Iconica* 1, pl. 5, fig. 35.
 1850 *Pleurotoma fagina* Adams and Reeve, *Zool. Voy. "Samarang,"* p. 40, pl. 9, figs. 2, a, b.
 1884 *Pleurotoma fagina* Adams, Tryon, *Manual of Conch.* 6, p. 167, pl. 3, fig. 22 (copy of Adams and Reeve's figure).
 1884 *Pleurotoma annulata* Reeve, Tryon, *Manual of Conch.* 6, p. 240, pl. 6, fig. 83 (copy of Reeve's figure).
 1917 *Turris (Tomopleura) fagina* Adams and Reeve, Melville, *Proc. Malac. Soc., London* 12, p. 146 (the Henjam specimen).
 1938 *Turris (Turris) fagina* Adams and Reeve, *Oostingh, De Ingenieur in Ned.-Indië, 4, Mijnb. Geol., 5(2),* Gast. 1, p. 27.
 1942 *Turris fagina* Adams and Reeve, Yen, *Proc. Malac. Soc., London* 24, p. 238, pl. 25, fig. 184 (photograph of holotype).

Types—What is probably the holotype of *annulata* Reeve is in the National Museum of Wales, Cardiff. The holotype of *fagina* is in the British Museum (Natural History) in London.

Records—PERSIAN GULF: Henjam Id., 46 fms., sand (Sykes coll., Brit. Mus.). INDIA: Bombay (MCZ). CHINA SEA: (holotype of *fagina*). JAPAN: 50 fms. off Tosa (ANSP). THAILAND: 4 mi. E. of Phuket Harbour, 80 ft. (R. T. Abbott, ANSP).

Fossil Records—JAVA: South Bantam, Pliocene (Oostingh, 1938, p. 27). TIMOR: Koto, Neogene (Brit. Mus., Geol. Dept.).

Turris amicta (E. A. Smith, 1877)

(Pl. 254, figs. 7, 8)

Range—Aden, west coast of India and Ceylon.

Remarks—The relationship of this species seems to be with *annulata* and in fact it appears in many collections under that name. The truncated canal suggests *Xenuroturris* but inclusion in *Turris* is influenced by the nature of the sinus rib which is of subsidiary strength, situated above the periphery and also by the nature of the sculpture which is very similar to that of *annulata*.

This species is of intertidal occurrence, evidently a shallow-water relative of *annulata*, which differs in having a much longer canal, dark-brown coloration and apparently no periostracum.

The type lot in the British Museum consists of three specimens and printed on the tablet is "Sand-

wich Is., W. H. Pease coll., two spec. M. C. [i.e. Museum Cuming] and smallest presented by Pease." An addition in pencil on the front of the tablet indicates Bombay as the locality and on the back of the tablet, also in pencil, is inscribed "Bombay (Abercrombie), certain!" All three specimens are of the well-known Indian shell, even the smallest one from Pease, so the "Sandwich Island" originally cited type locality can now be dismissed and Bombay substituted.

Description—Adult shell 45 to 53 mm. (about 2 inches) in height, white, devoid of colour pattern and covered by a yellowish olive periostracum. Adult whorls 10 to 11 (protoconch worn away in all available specimens). Spire tall, 1.5 times the height of the aperture plus canal. Whorls very lightly convex, sculptured with heavy spiral ridges separated by narrow interspaces. On the spire whorls there is a massive subsutural ridge traversed by 3 spiral cords, followed by the much weaker and narrower concave sinus rib which is margined top and bottom by weak cords. Below this is a third spiral ridge and a fourth becomes emergent toward the last whorl. About 10 spiral cords on the base with 1 to 3 secondary spirals in each interspace. Five more closely spaced spirals on the weak anterior fasciole. Body whorl elongate but with excavated base and short slightly-flexed anterior canal. Sinus moderately deep, narrow, U-shaped, situated slightly above the periphery.

Measurements (mm.)—

height	width	
52.0	17.0	Eluvativu Id., Ceylon
49.0	16.5	Bombay, India
46.0	14.5	Bombay, India
40.0	12.0	Bombay, India

Synonymy—

- 1877 *Pleurotoma amicta* E. A. Smith, *Ann. Mag. Nat. Hist.* (ser. 4) 19, p. 488.

Types—The holotype is in the British Museum (Natural History) in London. The type locality of "Sandwich Islands" is undoubtedly erroneous.

Records—ADEN: (Brit. Mus.). WEST PAKISTAN: (ANSP). INDIA: Bombay (Winckworth coll., Brit. Mus.); Bandra, north of Bombay (USNM). CEYLON: Eluvativu Id. (G. and M. Kline, 1957, ANSP).

Turris undosa (Lamarck, 1816)

(Color pl. 181, fig. 20; pl. 254)

Range—Southern India, Philippines, Japan and Queensland.

Remarks—This very distinctive species is easily recognised by its long spire, with almost straight

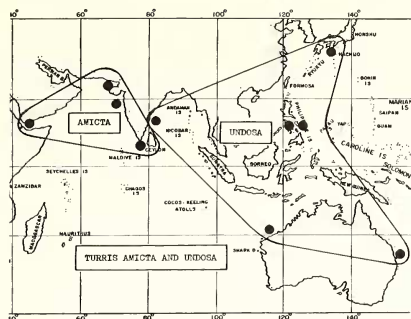


Plate 258. Geographical distribution of *Turris amicta* (E. A. Smith) and *Turris undosa* (Lamarck).

outlines, and by its very short anterior canal, profuse dark-brown wavy vertical maculations and violet-tinted aperture.

Tryon's figure of this species, which is copied from Reeve (1843, pl. 3, fig. 18), gives a false impression, since the maculations appear as prominent nodes, which they are not.

Description — Adult shell 65 to 83 mm. (about $2\frac{1}{2}$ to 3 inches) in height. Spire angle 24° to 25° . Height of aperture plus canal about three-fourth the height of the spire. The sculpture consists of a prominent, broad, subsutural fold bearing 5 narrow, sharply raised, spiral threads. Immediately below this is the rather prominent sinus rib which is slightly rounded; on the body whorl it develops 3 weak spirals. Below the sinus rib and over the base there is an assorted arrangement of spiral cords and threads, 4 more prominent than the rest, bunched in the peripheral area, and 7 or 8 primaries irregularly disposed over the neck, with from 1 to 3 threads in the interspaces. Colour pattern of dark reddish brown, vertical, wavy, dense maculations on a white ground. Interior of aperture, parietal callus and pillar stained bright violet.

Measurements (mm.) —

height	width	no. whorls	
83.0+	22.5	12+	Kii, Japan
76.0	22.0	—	Moluccas
65.3+	16.7	12+	Mindoro Id., Philippines

Synonymy —

- 1816 *Pleurotoma undosa* Lamarck, Encyclop. Méth., pl. 439, fig. 5, Le Liste, p. 8.
 1822 *Pleurotoma undosa* Lamarck, Anim. sans Vert. 7, p. 95.
 1839-40 *Pleurotoma undosa* Lamarck, Kiencr. Coq. Viv. 5, Pleurotome, p. 13, pl. 3, fig. 2.

1843 *Pleurotoma undosa* Lamarck, Reeve, Conch. Iconica 1, pl. 3, sp. 18.

1884 *Pleurotoma undosa* Lamarck, Tryon, Manual of Conch. 6, p. 166, pl. 3, fig. 21.

Records — INDIA: Madras (Winckworth coll., Brit. Mus.). JAPAN: Kii (ANSP). PHILIPPINES: Masbate Id., on coral reef (Cuming coll., Brit. Mus.); Calapan, Mindoro Id., (MCZ). AUSTRALIA: Queensland: trawled, Tin Can Bay, south of Fraser Id. (Mrs. J. Kerslake); Western Australia: between Malus and Gidley Ids., 10-14 fms., Dampier Arch. (W. Austr.-Hawaiian Exped., 1960).

***Turris cryptorhaphae* (Sowerby, 1825)**

(Color pl. 181, figs. 14, 15)

Range — Philippines, East Indies, New Guinea, Marshall Islands and Fiji.

Remarks — Although described as early as 1825, this handsome species is known from relatively few specimens. It is characterized by its rather short and usually pseudo-umbilicate siphonal canal, by its lavender aperture, and by its smoky brown color which is overlaid by numerous, fine, spiral, dark-brown lines. Some specimens may be light-tan and with light-brown spiral lines.

Description — Adult shell 65 to 78 mm. ($2\frac{1}{2}$ to 3 inches) in height, with a tall, attenuate, pagodiform spire and a short, twisted anterior canal. Colour uniformly chestnut or yellowish brown, the aperture and parietal callus tinged with violet. Spire angle 15° to 17° , outlines angulated at the lower third of whorl height by a prominent, smooth, narrowly rounded cord, a weaker one above and a third, a stronger one, emergent on the base, just

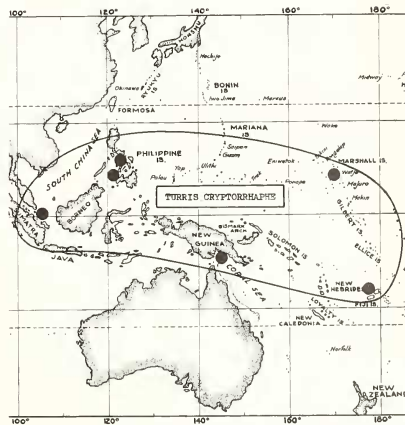


Plate 259. Geographical distribution of *Turris cryptorhaphae* (Sowerby).

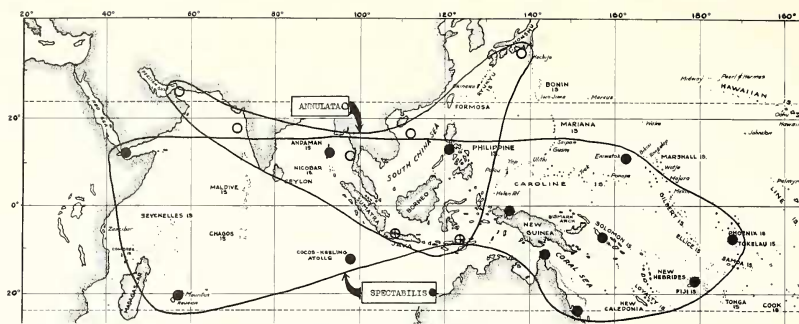


Plate 260. Geographical distribution of *Turris spectabilis* (Reeve) in solid dots, and *Turris annulata* (Reeve) in open circles.

Records — INDONESIA: North Ubian, 16-23 metres (Schepman, 1913). PHILIPPINES: 12-24 ft., E. side of Jagollao Id., N.W. end of Bohol Id. (duPont-Acad. Exped., 1958; ANSP); Zamboanga City, Mindanao Id. (MCZ); Masbate Id. (Brit. Mus.). NEW GUINEA: Milne Bay (Stanford Univ.); MARSHALL ISLANDS: Kwajalein Atoll (USNM). FIJI: Ngalito Id., off north coast, under rocks partially buried in sand (W. Jennings, 1961).

covered by the last whorl. Sinus rib narrow, low and inconspicuous on the spire's whorls and situated immediately below the weak subsutural fold. Surface further sculptured with fine threads, 2 or 3 on the subsutural fold, 2 to 4 between the peripheral keels of the last whorl and 12 to 15 on the base and neck. Aperture plus canal half the spire height. Pillar twisted and with a prominent fasciole and false umbilical chink.

Measurements (mm.) —

height	width	no. whorls	
78.0	21.0	14+	Bohol, Philippines
67.0+	21.0	—	holotype of <i>cryptorhaphes</i> Sby.
67.0	17.7	11+	Philippines
59.0	16.5	—	Bohol, Philippines

Synonymy —

- 1825 *Pleurotoma cryptorhaphes* Sowerby, Tankerville Cat., Append., p. 14, no. 1503 (no locality).
 1828 *Murex bicarinatus* Wood, Index Testaceol. Suppl., p. 15, pl. 5, fig. 7 (no locality).
 1839-40 *Pleurotoma woodii* Kiener, Coq. Viv. 5, Pleurotome, p. 12, pl. 7, fig. 1 (new name for *bicarinatus* Wood).
 1842 *Pleurotoma cryptorhaphes* Sowerby, Reeve, Conch. Syst. 2, p. 188, pl. 234, fig. 16 (15 in error on plate).
 1843 *Pleurotoma cryptorhaphes* Sowerby, Reeve, Conch. Icon. 1, pl. 1, fig. 7.
 1875 *Pleurotoma cryptorhaphes* Sowerby, Weinkauff, Conchyl.-Cab., 2nd series, Pleurotomidae 4(3), p. 20, pl. 4, figs. 4-7.
 1884 *Pleurotoma cryptorhaphes* (sic) Sowerby, Tryon, Manual of Conch. 6, p. 168, pl. 3, figs. 30, 31.
 1913 *Pleurotoma* (*Hemipleurotoma*) *cryptorhaphes* (sic) Sowerby, Schepman, Siboga Exped., pt. 5, 49e, p. 400.

Types — The holotype is in the British Museum (Natural History) in London.

Turris spectabilis (Reeve, 1843)

(Color pl. 181, figs. 16, 17)

Range — Western Indian Ocean to Melanesia and the Phoenix Islands.

Remarks — This gaily painted shell was relegated to the synonymy of *babylonia* by Tryon (1884, p. 162) but it is distinct from that species in having a shorter anterior canal, different sculpture and a characteristic colour pattern. It resembles *garmonsii* in its slender whorls and tendency toward wide dash-like maculations but differs in the shorter canal and broad light-brown zones both on the shoulder and on the base. It is evidently an uncommon species.

Description — Shell up to 80 mm (3 inches) in height. Spire 30° to 32°, tall but rather broad, 1.2 times the height of the aperture plus canal. Spire whorls with a single, narrowly rounded, spiral cord in place of the subsutural fold. Sinus rib narrow and rounded, weakly gemmate over the early whorls. Peripheral carina massive, followed below by a less prominent spiral keel, just emergent at the lower suture. On the base there are 6 additional primary cords which are strong, although narrowly rounded and wide-spaced. Colour variegated, basically golden-brown except for a broad, white, peripheral band. All primary spirals maculated with dark-brown dashes and dots.

Measurements (mm.)—

height	width	
80.2	22.3	Direction Id., Cocos-Keeling (ANSP)
76.0	20.0	Cebu Id., Philippines (Brit. Mus.)
68.5	20.0	Cebu Id., Philippines (Brit. Mus.)
64.0	19.5	Mios Woendi, Dutch New Guinea (ANSP)
55.0	16.5	Cebu Id., Philippines (Brit. Mus.)
42.0	15.0	Mauritius (Powell coll.)

Synonymy—

- 1843 *Pleurotoma spectabilis* Reeve, Conch. Iconica 1, pl. 1, fig. 6, a, b.
 1875 *Pleurotoma spectabilis* Weinkauff, Martini and Chemn., Conch.-Cab., Pleurotomidae 4(3), p. 22, pl. 4, fig. 9.
 1922 *Turris spectabilis* Hedley, Rec. Australian Mus. 13(6), p. 217.

Types—The type locality is Ticao Id., Philippines, Hugh Cuming, collector. The type was not located in the British Museum (Natural History). There are three specimens in the Cuming collection fastened to a wooden tablet and the middle one resembles Reeve's figure, but they are labelled "Island of Zebu."

Records—MAURITIUS: (A. W. B. Powell coll.). ADEN: (Australian Mus.). COCOS-KEELING: Direction Id. (V. Orr and R. Ostheimer, 1963, ANSP). ANDAMAN ISLANDS: near Port Blair (Natal Mus.). PHILIPPINES: Ticao Id. (type); Cebu Id. (Cuming coll., Brit. Mus.). DUTCH NEW GUINEA: reef 1 mi. N.E. of Mios Woendi Id., Padaido Ids. (NSF, 1956, ANSP). SOLOMON ISLANDS: Malaita Id. (Powell coll.). AUSTRALIA: Queensland: 20 fms., Darnley Id. (Australian Mus.); Tryon Id., Capricorn Group (Mrs. J. Kerslake). MARSHALL ISLANDS: Eniaetok Id., Rongelap (USNM). FIJI: Ngalutlo Id., off north coast, under rocks partially buried in sand (W. Jennings, 1961). PHOENIX ISLANDS: Canton Id. (Cal. Acad. Sci.).

Turris ambages Barnard, 1958

Range—Off Natal and Zululand, South Africa.

Remarks—No figure of the complete shell is given, just two line drawings, one of the protoconch and one of the sculptural detail of one whorl (which whorl not stated). The only clue to the location of this species is the author's comparison of it with *fagina*.

Nothing further can be done with this species without recourse to the type specimens and from the description it would appear that all of these are immature.

Description (from the original)—"Protoconch 3 whorls, diam. 1.25 to 1.3 mm., alt. 1.3 to 1.5 mm., with axial riblets (as in *Turris*). Postnatal whorls with four strong spiral keels (profile of whorl 4 lobate), 1st rather sharp, forming the cingulum, 2nd rounded forming the lip sinus, with growth-lines

producing more or less conspicuous squamiform nodules, 3rd the most prominent, rounded, forming the periphery, below this the smaller 4th keel; base with about 10 additional lirae. 17×7 mm. (protoconch and 7 whorls); 25×8 (protoconch and 8 whorls); a broken specimen 30 mm. long, with 5 whorls corresponding to the 5th to 8th whorls plus a portion of the 9th whorl. The 17 mm. example is whitish, with traces of irregular brown spots and streaks."

Measurements (mm.)— (See above)

Synonymy—

- 1958 *Turris ambages* Barnard, Ann. South African Mus., 44, p. 148, fig. 23b.

Types—The holotype is in the South African Museum.

Records—SOUTH AFRICA: Off Cape Natal (Durban), 54 fms., 2 broken specimens; off Umkomas River, 41 fms., 1 (17 mm. long); off O'Neil Peak (Zululand), 90 fms., 1 (25 mm. long).

Australian Tertiary Species

Turris selwyni (Pritchard, 1904)

Range—Balcambian Miocene of Victoria, Australia.

Remarks—Related to *septemlirata* but a smaller shell, 28 to 38 mm. (1 to 1½ inches) in height, proportionately broader, with the spire less than height of aperture plus canal. Sculpture consisting of spiral keels, two on early whorls, three medially and a fourth half-emergent over the last half-whorl. The sinus rib is composed of a pair of sharp cords with a smooth, narrow, concavity between, and this is situated just above the greatest convexity, at about two-thirds whorl height.

This and the following Australian Miocene species resemble Recent *annulata*.

Measurements (mm.)—

height	width	
38.0	17	holotype
32.7	14	Balcombe Bay, Victoria

Synonymy—

- 1904 *Pleurotoma selwyni* Pritchard, Proc. Roy. Soc. Vict. 17, p. 326, pl. 19, fig. 1.
 1944 *Turris selwyni* Pritchard, Powell, Rec. Auck. Inst. Mus. 3(1), p. 8.

Records—AUSTRALIA: Muddy Creek, lower beds, Victoria (type); Balcombe Bay, Victoria (Balcambian, Miocene).

***Turris septemlirata* (Harris, 1897)**

Range — Balcombian Miocene of Victoria, Australia.

Description — Adult shell 50 to 60 mm. (2 to 2½ inches) in height, broadly fusiform, with an attenuated spire but a somewhat truncated and twisted anterior canal. Spire 1.3 times the height of the aperture plus canal. Sculpture of prominent, rounded spiral keels, 4 on the penultimate; the rather deep and narrow sinus is situated on the second keel from the top, which is the one just above the greatest convexity of the whorls. The species bears some resemblance to the Recent *annulata* Reeve.

Measurements (mm.) —

height	width	
60.0	22.0	holotype
46.0	16.0	Muddy Creek, lower beds

Synonymy —

- 1896 *Pleurotoma perarata* (Tate ms.) Cossmann, Ess. Pal. Comp. 2, p. 77.
 1897 *Pleurotoma septemlirata* Harris, Cat. Tert. Moll. Brit. Mus. 1, p. 39, pl. 2, figs. 10a-d.
 1898 *Pleurotoma septemlirata* Harris, Tate, Proc. Roy. Soc. N.S.W. 31, p. 392.
 1944 *Turris septemliratus* Harris, Powell, Rec. Auck. Inst. Mus. 3(1), p. 8.

Types — The holotype is in the British Museum (Natural History).

Records — AUSTRALIA: Muddy Creek, Victoria, "Eocene" = Balcombian, Miocene (type); Muddy Creek, lower beds; Grice's Creek and Altona Shaft, Victoria (Balcombian).

? *Turris ugaliensis* Makiyama, 1927

Range — Japan, Kakegawa Series (Lower Pliocene) and Tano (Middle Miocene).

Remarks — This species should not have been described, for the type specimen consists solely of a broken shell of which only the body whorl remains. The Miocene material ascribed to this species, with reservation, by Shuto (1961, p. 79) is also imperfect.

The original author compared his species with *unedo* Kiener (which is an *Unedogemmula*) to *leucotropis* (which is a *Lophioturris*) and *gendinganensis* Martin (which is considered to be a synonym of *Lophiotoma* (*Lophioturris*) *indica* (Röding)). No useful purpose can be served by trying to evaluate this species on the evidence at present available.

Synonymy —

- 1927 *Turris ugaliensis* Makiyama, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, 3(1), p. 93, pl. 4, fig. 18.
 1952 *Turris ugaliensis* Makiyama, Hatai and Nisiyama, Sci. Rep. Tohoku Univ., 2nd Ser., Geol. Spec. 3, p. 263.
 1961 *Turris* cf. *ugaliensis* (sic) Makiyama, Shuto, Mem. Fac. Sci. Kyushu Univ., Ser. D, Geol., 11(2), p. 78.

Genus *Antiplanes* Dall, 1902

(Pl. 261)

Type: *Pleurotoma voyi* Gabb, 1866

This moderately large, sinistral shell and its dextral forms *Rectiplanes* and *Rectisulcus* are mostly deep-water and characteristic of low temperatures. They range from off the Californian coast to Alaska and around the Bering Sea to Kamchatka and Japan. Also post-Pleistocene of California.

The genus could be regarded as a benthic, Boreal, cold-water development from *Turris*, in which a great reduction in sculpture and the acquisition of a thick periostracum has taken place, this latter feature being typical of high latitude shellfish that have to contend with the greater erosive action of ice-diluted sea water.

The sinus is broadly open, extending from the suture to below the periphery but the actual apex of the sinus is immediately above the greatest peripheral convexity. The shell ranges to 55 mm. (2¼ inches) in height, has a tall narrow spire but a truncated anterior end. Operculum leaf-shaped, with apical nucleus. Protoconch smooth, paucispiral and globular with an asymmetric inrolled top. Radula a pair of "wishbone"-shaped marginals plus a vestigial central tooth.



Plate 261. *Antiplanes voyi* (Gabb, 1866). Eastern Pacific Recent, deep-water. 40 mm. (*perversa* Gabb, 1865, non Philippi, 1847).

Although this genus occurs off the coasts of warm temperate localities, Japan for instance, it is confined to the colder waters of the sea bottom, and thus cannot be considered inclusive in the Indo-Pacific fauna.

Synonymy —

1902 *Antiplanes* Dall, Proc. U. S. National Mus., 24, p. 513.Type by original designation: *Pleurotoma perversa* Gabb, 1865 (non Philippi, 1847) = *voyi* Gabb, 1866.

Characteristic Species — POST-PLIOCENE TO RECENT: *voyi* Gabb, 1866; *contraria* Yokoyama, 1928; *kamchatica* Dall, 1919; *major* Bartsch, 1944.

Subgenus *Rectiplanes* Bartsch, 1944

(Pl. 262)

Type: *Pleurotoma* (*Antiplanes*) *santarosana* Dall, 1902

This subgenus differs from *Antiplanes* in being dextral instead of sinistral.

Synonymy —

1944 *Rectiplanes* Bartsch, Proc. Biol. Soc. Washington, 57, p. 59. Type by original designation: *Pleurotoma* (*Antiplanes*) *santarosana* Dall, 1902.

Characteristic Species — RECENT: *litus* Dall, 1919; *rotula* Dall, 1921; *sanctioannis* E. A. Smith, 1875; *santarosana* Dall, 1902; *thalaea* Dall, 1902; *kawamurai* Habe, 1938.

Subgenus *Rectisulcus* Habe, 1958Type: *Rectiplanes* (*Rectisulcus*) *motojimai* Habe, 1958

This subgenus differs from *Rectiplanes* only in having spiral cords on the surface and in lacking longitudinal cords on the early whorls. Recent, Japan. It seems to have insufficient distinction from *Rectiplanes*.

Synonymy —

1958 *Rectisulcus* Habe, Venus, Tokyo 20(2), p. 184. Type by original designation: *Rectiplanes* (*Rectisulcus*) *motojimai* Habe, 1958.

Characteristic Species — RECENT: *isaotakii* Habe, 1958; *motojimai* Habe, 1958 (both off Choshi, Chiba Pref., Honshu Id., Japan).

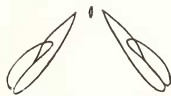


Plate 262. Radula of *Rectiplanes santarosana* Dall. Eastern Pacific, Recent (prepared and drawn by J. P. E. Morrison, U.S. Nat. Mus.).

[These occasional blank areas occur between genera and subgenera to permit the insertion of new material and future sections in their proper systematic sequence.]

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